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"ELECTRICAL REVIEW."

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THE

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A STATISTICAL REVIEW OF ELECTRIC TRACTION.

MR. J. N. DUNLOP has served to the Tramways and Light Railways Association a very palatable dish of figures. Aided by the lately-issued U.S.A. Census Report, and by other official papers relating to the tramways and railways of France and Germany, he has compiled a financial statement that is not in the least dry, and is enough to make any investor in electric traction undertakings refuse to sell on the highest rise.

Readers of this Journal have seen most of the figures before, but in a scattered form, therefore without the same significance which they now bear to one another.

The lessons to be learnt are the same that we have been taught, and have taught, for years. The conversion of tramways and light railways from steam, or cruder power, to electric driving invariably reduces operating expenses per mile run, increases the frequency of service, the number of passengers and the frequency of travelling, and increases the gross revenue sufficiently to pay fair to good interest on old and new capital, although the fares are always reduced heavily.

Emphasis is laid, again, on the oft-explained magnitude of electric traction undertakings in America as compared with Britain. Stated here in terms of the capitalisation of steam railways the figures are 33 per cent. for the U.S.A. and 6 per cent. for Great Britain. Since 1890 the track mileage of the U.S.A. has increased 1,627 per cent. (1902); while in Germany between 1896 and 1902 there has been an increase of 500 per cent.; but in France the progress has not been so promising.

The Americans, with their enormous possibilities of expansion, have been throwing down rails and "ties" in their well-known breathless fashion for some years, and they have developed the "inter-urban" railway at an astonishing pace, perhaps in some cases a little too precipitately.

Averaging 18 of the largest American concerns the operating expenses are 60·4 per cent. of the gross receipts, this figure including 8 per cent. for taxes.

The following statement shows the relation of the various divisions to the total operating expenses of the whole of the street railway companies in the U.S.A.:—

Maintenance of works and ways ...	8·52	per cent.
„ of equipment	11·72	„
Operation of power plant	16·20	„
„ of cars	43 88	„
Miscellaneous	18 14	„
Wages, supplies, &c., incidental to electrical service	1 54	„
	100·00	„

It is interesting as showing once more how relatively unimportant is the cost of power.

Although the gross receipts per passenger in the States

average 1·99d., the receipts per car-mile average only the same as in England, where the receipts per passenger do not reach 1·25d., proving that the density of population is not so great.

Germany ranks with us in the matter of receipts per passenger, these averaging 1·16d.

The development of electric traction in Germany has made the manufacturing crisis less acute than it might have been, and the following figures give the increases of 1902 over 1901.

Central power stations	10·6%	Number of trailers ...	60·3%
Length of line ...	9·3%	Capacity of generators ...	13·0%
„ of single track	13·2%	„ of accumulators	11·7%
Number of motor-cars	69·4%		

These figures are particularly instructive as showing clearly how the track load factor is increasing. While the track itself has lengthened only 13 per cent., the number of cars using the track has increased 66 per cent. Every year, therefore, the earning power of the largest part of the capital is enormously strengthened. In the same way the capacity of the generating plant supplying this increased number of cars has itself risen by 13 per cent. only, so that it is reasonable to suppose that working costs have diminished with the better general load factor.

The large street railway systems of America carry the population served from 80 to 160 times per annum; while, when Glasgow's system comprised 45 miles of route, the population was carried 174 times per annum in 1902.

While in England the average consumption of energy per car-mile is a little over 1 unit, the wholly different conditions in the States raise this figure to anything between 2¼ and 5 units. This is accounted for readily by the general use of double-truck, heavy, single-decked cars, motored for high speed and high acceleration. The mean speed through urban districts is much in excess of our allowances, and in the country districts 40 to 50 miles per hour is usual practice, while the use of trailers, and of multiple unit trains of two or more cars, is common, and has the effect of raising the units per car-mile.

Mr. Dunlop gives the average energy per ton-mile as between 80 and 170 watt-hours. Similar figures for Britain would be instructive, and might be expected to be favourable to the States, where rail-grooves are absent, or much wider than ours, and where with so much country track the rails will be clean.

Turning to the electrification of railways, the author remarks with much truth that "it is not by reducing expenses that electric traction will be made advantageous to railways . . . ." He does not endeavour to prove that conversion of main lines is economically possible, but he shows, by the method of quoting further statistics, that there is already a distinct tendency in that wider direction.

Indeed, anyone who reads the American traction journals must feel that the development of interurban lines has gone far past the tramway, or even the light railway, stage.

At any rate, in the matter of distances, some of these railways compare with our smaller main steam lines. Power is transmitted over several hundred miles in some instances, the permanent way is constructed after the best American main line fashion, Pullman cars in regular trains are used, and speeds are as high as, and, in some instances, higher than steam line speeds. The main difference is that goods are not handled to any great extent, although, where they are touched, the electric rates cut the steam rates.

Of course, the Valtellina and the Milan—Varese experiments are quoted, and an interesting comparative statement shows that, in point of weight, seating capacity, and speed, the direct current system has all the advantage. This is followed by another table comparing the cost of operating steam (8 trains per diem) and electric (28 trains per diem) trains both in England and Italy. A saving of 40 per cent. is shown for each country, but we do not know where Mr. Dunlop obtained the English costs. The table can be of little permanent value.

The average cost of urban electric railways is given as follows:—Berlin, £241,000 per mile; Paris, £281,630 per mile; and London, £603,490 per mile. That shows well enough with what difficulties the engineer who tries to improve London has to contend, and it must make the mouths of the shareholders water to think how enormous their dividends might be if the construction rate per mile were as low as in less crowded Continental cities.

The paper ends with a comparison from actual working examples of the conduit and trolley systems, and very striking it is. We all know how enormous the L.C.C. have made the difference in constructional cost, but we see here that the operating expenses as well come out with heavy advantages on the side of the trolley.

In Brussels the conduit lines cost ·3125d. per mile more than the trolley lines in the same city.

In Paris (1902) the difference was ·459d.

The review is optimistic; but, we believe, not unduly so. The only fault we have to find with it is that it is inclined to scrappiness, and is a little superficial in parts.

Wireless Telegraphy.

Under the heading of "Science Notes" and the title of "The History of a Great Invention," the *Daily News* of Tuesday, October 27th, published an article upon the genesis and history up to the present time of Wireless Telegraphy. This article, despite noteworthy omissions, is so commendable on the combined score of comprehensiveness and impartiality, that if space allowed we would reproduce it in full. In attributing the first idea of attempting the achievement of telegraphic communication through the ether to Prof. Dolbear, of the United States, the writer of the article does not, of course, go far enough back, but the work of that professor, and of other and well-known authorities and inventors in this field from Hertz, Edison, Oliver Lodge, Branly, Preece, Popoff, Marconi and de Forrest downward, is clearly and succinctly traced. The Lodge-Muirhead system, with its beautiful self-restoring coherer, is specially noticed.

In speaking of Signor Marconi's ingenious adaptation and application to practical purposes of discoveries made by others, the *Daily News*, on the strength, doubtless, of his own statement, as made in his one paper before the Institution of Electrical Engineers (in March, 1899), points out that the novelty claimed by him is the introduction of the vertical wire at one station, if not at both stations. Opinions upon the novelty and patentability of this device must, of necessity, differ, but the question may possibly be fought out and definitely determined in process of time.

The article of our contemporary is of distinct educational advantage. It is on reading such articles that

the lay world will realise as clearly as the scientific world generally has done throughout, the great number of eminent physicists and workers in all countries to whose aggregate inventions and labours is due the creation of so-called wireless telegraphy, and such progress as has hitherto been made with the new system as a practical science.

The lay press may possibly now think it well to turn their attention to an investigation into the causes which have led to the seeming failure on the part of its sponsors to inaugurate their promised "wireless" service across the North Atlantic. Moreover, investors in this enterprise will, perhaps, decide, if they have not already decided, to press in the proper quarter for something more than the vague generalities and explanations furnished to them on the subject, through the medium mainly of erratic and irresponsible newspaper paragraphs.

The Manchester *Suppressio Veri*.

As mentioned briefly in our last issue, the City Council at its last meeting adopted a course with regard to the City Electrical Engineer which was thoroughly characteristic, and, to quote a local paper, "not altogether creditable." Instead of insisting upon a full and complete investigation into the circumstances attending Mr. Metzger's resignation, the only just and upright course open to it, the Council adopted a policy of silence, and accepted the report of the Electricity Committee without a word of discussion. Not only this, but it deleted from the record the statement that the reason for the engineer's resignation was his "inability to work in unity with the deputy chairman," the only shred of explanation which appeared in the report of the Committee. As to the personal qualities of Mr. Metzger, the chairman did him the tardy justice to admit that the engineer had carried out his duties earnestly and successfully, and no question has been raised from first to last as to his professional ability; the Corporation, in fact, is sacrificing its engineer in the hope of "saving its face" and avoiding a public inquiry, which, no doubt, would reflect no credit upon its members, although it would enable the engineer to obtain the justice which is the right of every British citizen. Our sympathies are with Mr. Metzger, who, in our opinion, has received scurvy treatment at the hands of the municipality. But what else could he expect in that quarter?

The Institution of Electrical Engineers.

Next Thursday the new session of the Institution will commence; in anticipation thereof we venture once more to draw attention to certain features of the proceedings in which, in our opinion — and we do not stand alone — important improvements might easily be effected, conducing to the efficiency of the discussions and increasing the output.

First of all, the present practice of reading the minutes at the commencement of each ordinary meeting is superfluous, and entails a waste of valuable time. Only two hours are available for the whole of each day's proceedings; economy of time is, therefore, of the first importance. The minutes might be printed on the announcements of meetings, and taken as read.

For the same reason copies of the papers should be sent in advance to every member, at any rate in the London district, and it should be understood that the papers would not be read by their authors at the meetings. Those members who rise to say that they "have not had time to read the paper, but would like to ask" &c., ought to be promptly suppressed by the chairman, as things are; under the suggested *régime*, knowing that the papers would not be read in the meeting, perhaps they would find time to scan them in advance. The author might with advantage, in some cases, preface the discussion with a few introductory or explanatory remarks, but even these might generally be omitted, it being clearly understood that the paper is submitted to the *Institution*, not to the *meeting*, and that the latter is merely concerned with the discussion of the points raised. Another and most weighty objection to the reading of the papers by their authors lies in the utter inability of many of the latter to read aloud. We admit, with pleasure, that there are exceptions; but the above is the rule.

Next, we venture to protest against the waste of time in butter. Let it suffice for the first speaker in the discussion to express the thanks of the members to the author for his paper—preferably, the chairman alone need pay this graceful tribute. Afterwards there is no need for every speaker to flatter the author before, perhaps, rending his paper to rags. The Institution is not a mutual admiration society, but a business association, and its business is electrical engineering, not dairy work.

It seems useless to suggest, once more, that those who have nothing to say should say it, and refrain from wearying the meetings with long recitals relating to the days of their youth. We honour and respect the pioneers of the profession, and we are ever ready to hear their views on technical subjects; but we live in the present, and reminiscences of things that happened more than 10 years ago are rarely of any value whatever to electrical engineers of to-day, whose art is ever-changing. Like Mrs. Battle, we want "the rigour of the game."

Our suggestions are put forward in the best interests of the Institution and of the profession, and we trust that they will be taken in that spirit.

Lastly, we wish to remind our readers of the fact that the Institution has become the possessor of a building site in Westminster. Now is the time, before further steps are taken, to discuss the possibility of realising the proposal that the engineering societies shall join their forces and erect a central Engineering Institution. We may add that the four leading engineering organisations of the United States some time ago resolved to follow this course, and appointed a joint committee to carry it out.

Phosphorescence of Minerals by Radium.

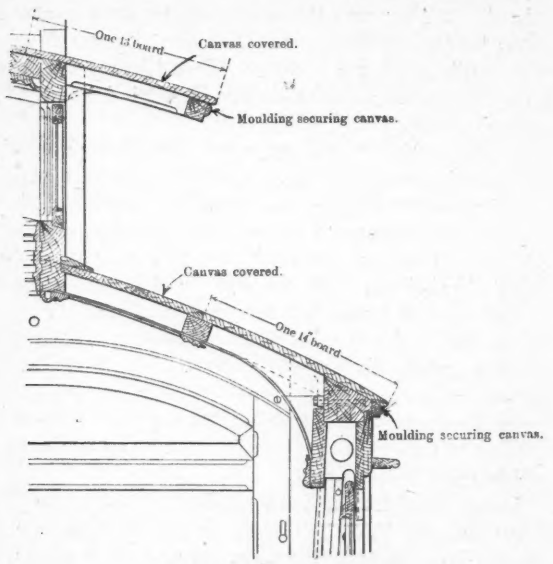
Some interesting experiments on the excitement of phosphorescence in minerals have been carried out by Kunz and Baskerville in the United States. The radium employed in the experiments had a radio-activity of 300,000. Under its influence it was found that some diamonds would phosphoresce, but others would not. The phosphorescent diamonds retained the property for some time after they had been removed from the influence of the radium. The mineral, Willemite (a silicate of zinc), exhibited both fluorescence and phosphorescence, and Wollastonite showed a marvellous phosphorescence; but Kunzite phosphoresced under the action of radium with greater brilliancy than any other known substance. Kunzite is a new gem named after Dr. Kunz, and recently discovered in large crystals in California. It belongs to the felspar family, and is closely allied to spodumene. Phosphorescence is also excited in Kunzite by the Röntgen rays. A secondary radiation was excited in the Kunzite by exposure to a stream of Röntgen rays for a few minutes. These secondary radiations were capable of affecting a photographic plate through a sheet of thin paper. Kunz and Baskerville believe they have made a valuable discovery in connection with Willemite. By mixing radium with natural Willemite, pulverised to a powder, the activity of the former substance was multiplied a hundred-fold, and probably—for no instrument has been devised capable of measuring the increase of activity—a thousand-fold. That, at least, is the temporary effect of mixing the two substances; time alone will tell whether the increase will be permanent. It is possible that there is in Willemite some substance, not yet identified, which stimulates the activity of the radium.

D

A DETAIL IN CAR-BUILDING.

In these hustling days of generalities, and of leaving details to subordinates, it does one good to be held up for a moment by the description of some constructional detail which has a vital bearing on the life of the completed article. As a detail it may have existed unnoticed by you since birth, but its importance may be quite out of proportion to its appearance, and may remain unappreciated until it either forces itself, or is dragged, into notice.

As an instance we give a sectional drawing of the upper and lower roofs of a monitor decked car, directing especial attention to the beading or moulding under the outer ends of the roof boards. If you will take the trouble to examine



Section of Roofs of Car.

your own cars, you may find that this moulding, which holds the canvas roof covering in place, is not under and inside the drip formed by the projecting roof-board, but is screwed to the edge of the board.

As shown in the figure, water has an uninterrupted passage over both roofs, whereas in the second case, it has the chance of finding its way sooner or later between the edge of the roof-board and the moulding. This will result, inevitably, in the canvas rotting, whereupon that great enemy will penetrate to the heads of the pillars, and will work secret and grievous damage. Such damage, indeed, as, if not checked, will entail the rebuilding of the car.

Such a little point as this is laughably obvious when mentioned, and we believe that it is not likely to have been overlooked by any English car-builder, but it may carry an application to many a manager, perhaps indirectly. It may start them wondering whether there are any places on their cars where water has the slightest chance of lodging, whether the cleaners are made to remove damp holding dust from all corners inside or outside, and whether age or bad tracks are beginning to open up joints exposed to the weather. Really bad track begins to break up a car-body in a year, and the weather will assist dissolution at an ever-increasing rate. If, for some bad reason or another, it is impossible to renew the track, the ultimate loss should be kept as low as possible by stopping and filling, painting and varnishing, wherever a cracked skin or an opening joint is seen.

The text on which this note is based, and the illustration, appeared in the *Street Railway Journal* for August 8th.

SINGLE-PHASE MOTORS FOR TRACTION.

By Dr. GIORGIO FINZI.

Through an evolution of unprecedented rapidity, the machines that generate electric currents, or that generate mechanical work out of them, have almost reached perfection, while they more and more gravitate towards only one type of every class. These classes are—leaving transformers out of consideration—on one side generators of continuous currents, which are used identically as continuous current motors; then we have machines for generating single or polyphase alternating currents; lastly, there are induction or rotating field motors, whose function is the transformation of polyphase (exceptionally of single-phase) alternating currents into mechanical work.

Thus have the transmission and the distribution of energy found an extensive field; the transformation of alternate currents from a high to a low voltage, or *vice versâ*, and the beautiful simplicity of the induction motor, went far to allow of the economical use in industrial districts of huge powers brought by wire from distant places. When we think of the simple construction and of the high efficiencies of such machinery, we may almost conclude that the limits of their perfection are already reached.

At the same time electric street railway traction has taken the place of the horse tramcar system, and has developed much beyond it, driving also the other mechanical traction systems quite out of competition; this was because the aerial trolley with rail-return and with series continuous current motors at 500 volts was found to easily supply a convenient amount of power for this use; another step was to perfect converters to transform the normal three-phase high voltage current of transmission plants into continuous current at about 500 volts.

Thus was the difficulty surmounted of the inherent incapacity of continuous currents to being generated and transformed at high tension.

This same system does not become impossible even for long distances, but its economy disappears, and for railways of greater importance a further difficulty is to be faced in the great intensity of the currents through the trolley contact. This is our starting point in order to understand why a great movement has not yet been organised to replace steam traction by electric traction; for want of something better, that is to say, of a simple and a direct system, trains have been supplied with continuous current through a third rail and a shoe (these taking the place of the aerial trolley), and remarkable results have been attained from the lines thus equipped. The costly necessity of building at intervals of about 10 km., converting sub-stations for these lines, would disappear if means were found for directly feeding alternate currents into the trams at a pressure of some thousands of volts. Now, while polyphase induction motors are easy to build for high tension, they cannot well or economically work beyond narrow limits of speed; moreover, three conductors at least (or two if the rails are used for one) for the current present an almost prohibitive difficulty. This last statement may appear too sweeping if we think of the success of the Valtellina Railway; but the fitness of a system for a given industrial object, far from being proved by the success of any single plant, requires the extending of its application after the initial experiments. Now, from this point of view, the three-phase traction rather appears a *tour de force* little inviting repetition.

Single-phase induction motors are well left out of account. Desirable for the simplicity of current supply, they are deficient through all the range of speeds; only near to synchronous speed is their behaviour satisfactory at all, so that small industrial plants at a constant speed remain their only appropriate field.

It is peculiar to traction cases in general to call for a class of variable speed motors whose torque should always be a strong one, with a fair efficiency through the whole range of speeds. Even the normal speed should not be a limit, as it is necessary to gain on time occasionally. Also a simplicity of machinery and of controlling action is called for from which stationary plants can often be exempted.

No such qualities are found in the induction motor, and among continuous current machines the shunt motor is only partially suitable. Only the series motor approaches in flexibility the steam locomotive or the horse. Further, we should remember that even the series motor is deficient in starting, as under the best conditions it would require a variable voltage supply; if the line furnishes, as it generally does, a constant voltage, we are bound to use resistances in starting; equipments with more than one motor only give a partial remedy, allowing the motors to be coupled first in series, then in parallel,

An ideal case for electric traction is thus represented by the series motor with a variable voltage supply; now, a series motor is, *a priori*, a possible arrangement for alternate currents too; and a variable voltage obtained by very simple means is a leading feature of alternate current. Moreover, such a system allows the use of one trolley line with the rail as return, and offers no objections whatever to a high voltage that can be transformed with apparatus that require no supervision.

An incidental advantage is that we do away with the inconvenient electrolysis from the stray currents, the cause of disagreeable phenomena and of great expenditure in continuous current practice.

The electrical text-books, not excluding the most recent ones, bestow little or no attention on the series single-phase motor, or sweepingly condemn it on account of low power factor and sparking at the commutator; this is repeating Mr. Steinmetz's conclusions of 1896, which were the outcome of a necessarily incomplete theory, and of some unpromising experiments. As often happens, the statements of so eminent a scientist, though based upon the study of only one particular 4-H.P. motor, deterred many electricians from thinking and from designing series motors, as from a hopeless line of investigation. At that time another special motor seemed to me very well adapted for using alternate current. I allude to the continuous-current motor—marine type—a standard construction of the Brioschi Finzi Co., that served the needs of all accessory uses, on board the Italian men-of-war; its characteristics are a laminated multipolar field core with longitudinally divided poles, a small air-gap and low speed; lastly, a set of resistances connecting the armature windings to the commutator segments. Our present single-phase traction motor is nothing more than the natural development of the same ideas, and of the same design.

The longitudinal division of the poles, as often suggested, and sometimes used for continuous-current dynamos, is fully as important as the laminating of the field, as it forms the simplest means to kill the reaction flux of the armature. Another less satisfactory system which was also known from continuous-current dynamos, is to highly saturate the portion of the poles near the air-gap. This is attained in the Lamme single-phase motor through a number of holes in the poles, but only a portion of the iron remains, and hysteresis losses are higher.

Another system is to place short-circuited windings in the poles (Steinmetz-Stanley-Lamme), or to use a symmetrically distributed field winding supplied from opposite points and short-circuited at 90° from the points of supply (Latour); these subsidiary means again dissipate some energy, and leakage prevents them from attaining their end completely. Though the transverse flux be done away with, a greater difficulty remains: the sparking due to the short-circuiting (under the brushes) of the armature sections as secondaries of a transformer under the influence of the alternate current-fed field poles. Our marine motor already carried the best remedy that we know of even to-day—the German silver resistances connecting the windings to the commutator enter each in its turn into the inconvenient short-circuit, so that the maximum current flowing is brought down to a much lower figure. With a design giving a low reactance voltage in the armature sections, and with an appropriate shape of the poles, this remedy allows good series motors to be designed for traction use, for frequencies of 15 to 20 and more, and for 100 to about 300 volts.

I think it will be allowed that, after our experiments, the position that sweepingly condemns the series single-phase motor on account of its poor efficiency and power factor and its destructive sparking at the commutator is no longer tenable. It is only a question of time to see a number of such motors working under the various conditions of practice. But as the objections to the series motor have been lately (1903) collected more forcibly than ever before by M. Latour, with the object of contrasting its behaviour with that of a mixed-action motor devised by himself, let us see how far they prove true.

Here are the essential deficiencies of the series motor, according to M. Latour:—

The commutation is unsatisfactory at all speeds,

The wattless current is always pretty high,

The power is developed in that element of the machine to which a commutator is attached, making direct high-tension working impossible.

The heating of the stator is different in different points.

Now it is conceded by those who were present at the Milan trials, that *commutation was satisfactory at all speeds*; runs on the same conditions with continuous current on a G.E. 52-motor did not show a better behaviour at the brushes; and our commutator did not require the smallest care through all our experiments.

Moreover, it is a remarkable fact that such results have been attained with the simplest means, without having recourse to any roundabout devices; they are only due to adequate design, to suitable shape of the magnetic circuit, and to those resistances between windings and commutator which are not unprecedented in continuous current machines; while these resistances are in the single-phase motor higher than usual, their presence does not appreciably lower the efficiency, because at a given moment the whole current either passes through two of them only or through two pairs of them. To have killed the transverse reaction simply through dividing the magnetic circuit—not through special windings or by short-circuiting the main stator winding in symmetrical points—does away with an ohmic loss, and a non-symmetrical heating, which formed one of the reproaches of M. Latour to the series motor.

As to the wattless current, this is no great question *per se*; our power factor always reached pretty high values, so that no difficulty can be anticipated either about the line or about the generators.

The curves of our motor are the best answer to this objection; a motor that shows a power factor of 0·85 to 0·98 through a range of speed and voltage of 550 to 1,400 revolutions and of 80 to 160 volts with the torque necessary for the equipment used, cannot be condemned on account of the low power factor.

The third objection would only be a strong one if comparison were wanted with any other system that would readily lend itself to direct high voltage, and even then it is questionable indeed whether to have the high voltage in a traction motor instead of in a transformer be an advantage or a drawback; at any rate, it is interesting to note that when the high voltage central station generator itself is on many sides objected to on account of a lesser margin of safety, the same feeling is *a fortiori* justified when a motor is concerned, working under a tram on the road; nay, I would go so far as to say that the best traction system is to allow with the simplest controlling gear the highest voltage on the line together with a low-tension motor.

Besides, a fact to be noted in this connection is that the first experimental line where the mixed action motors are on trial, for which the advantages of direct high voltage and of higher frequency have been claimed by M. Latour, is a 25 ~ plant at 6,600 volts, while the motors are on the low-tension side with only 190 volts as a maximum. Such voltage and frequency are well within the actual margin of our simple series motor.

The mixed action motor for traction, according to Latour, has two brushes as a continuous-current motor, and another pair of brushes at 90° from the former ones, short-circuited as in a repulsion motor; only they are at 45° from the position they would occupy in a real repulsion motor of the usual kind.

This arrangement is to bring the power factor up to unity and to kill the sparking at the series brushes; on the other hand, it is admitted by Latour himself that commutation at the short-circuited pair is only good at synchronous speed, and that even in this motor a great number of commutator segments is a necessity. He suggests, too, to sever the connections between stator and rotor in starting; this is to sever the rotor from the high voltage of the line, making the motor work on the pure repulsion principle; but the short-circuited brushes are then to touch the commutator at 45° in advance (or behind, according to the direction of running), compared with their position at full speed and with the mixed action.

That good results can accrue from such a system is indeed probable; but neither better economy in working nor greater ease in controlling can be anticipated in comparison with our simple series motor, not to mention the drawback of working on two different principles in starting and at speed, of having to move or to lift some of the brushes from a

distance, and of having a limiting speed beyond which the sparking at the short-circuited brushes again begins to show itself.

Another mixed action motor has been devised, at first by Arnold, and manufactured by the Wagner Electric Co.; now Schüler has given it the finishing touch. The Wagner motor has a stator with a single-phase distributed winding, and a repulsion rotor with a short-circuiting and brush-lifting automatic device that turns the system into a pure induction motor when the starting has been accomplished.

The Schüler motor runs on the same principle, but the repulsion and the induction, instead of being clearly defined, mutually cover each other from starting point to full speed, the only difference being in the moving part, which is an ordinary rotary-converter rotor with a three-phase starting rheostat connected to the slip-rings, and short-circuited brushes on the commutator side. Thus the commutator makes it a repulsion motor, less and less active from starting to full (synchronous) speed, and the rheostat gives an induction motor more and more active from rest to full speed.

The Schüler motor is, after all, chiefly a good single-phase induction motor with a good starting torque, and for many uses it looks just what is wanted. Another question is whether it can be adapted in the first instance to the functions of a traction motor; here the maximum synchronous speed, beyond which it cannot run, is more of a drawback, while the necessity of rotating the repulsion brush-holder 90° for reversing the movement is not a welcome addition to difficulties of controlling, and to the three-phase rheostat, which has been an undesirable feature of three-phase traction. Its only advantage remains that its stator can be wound and used for direct high voltage, but controlling either on the high tension or on the repulsion brushes does not better the starting conditions, as the voltage control does on our series motor. All these characteristics would, of course, lower the economy in starting.

Summing up, the series single-phase motor at a constant voltage automatically regulates its speed according to the load put on, the speed at high loads being inversely proportional to the load; it allows a voltage control without losses, and the widest speed limits. As against these advantages, it cannot use high voltage directly, and it is for the present bound to comparatively low frequency; but the voltage controller can be combined with the transformer, and the other feature is only an obstacle when the use for traction of ordinary light and power plants is considered.

The Latour motor bears a high voltage at speed, but not in starting unless it be used as a repulsion motor, thus losing some desirable qualities of the series motor; voltage control in starting would, anyhow, call for rheostats or transformers, so that direct high voltage is more illusory than would at first appear. Moreover, the high voltage would appear at the series brushes, also beyond synchronous speed; while as a repulsion motor it would develop no torque. Again, the frequency used by Latour is not particularly high (25 ~).

Lastly, the Schüler motor bears high voltage, and is made for high frequency (50 ~). But the voltage control in starting is again deficient, and requires complications in practice; again, the highest speed has the same limit as an induction motor would have.

The significance of the single-phase series motor for street railways and for railway work cannot be measured definitely in general for want of suitable data; traction problems are apt to vary so much from case to case and their treatment is so complex, that we must expect this question to lose only slowly the vague outline it shows at the present time. But plans for the electrification of individual lines have been described where the elements of steam traction have been as carefully compared with those of electric traction as at all possible, the result being often favourable to electric enterprise, notwithstanding the unmistakable deficiencies both of continuous current and of three-phase current, when all conditions are duly taken into account.

The preceding discussion and the results of our experiments have shown that those deficiencies are not to be found in the single-phase system. Now, in a multitude of cases such a step in the direction of better service and economy is all that is wanted in order to make electric traction to assert itself as the successful competitor with the steam system.

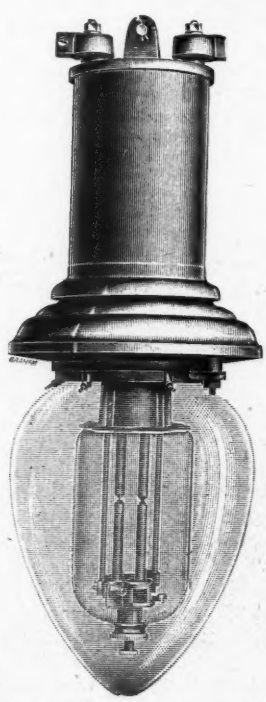
(To be concluded.)

DEVICES AND FITTINGS FOR THE CURRENT ELECTRIC LIGHTING SEASON.

(Continued from page 697.)

"Angold" Arc Lamps.

The General Electric Co., Ltd., have issued a new catalogue, giving prices and particulars of the "Angold" arc lamps and accessories. This list comprises the whole range of arc lamps as sold by the company, together with all necessary accessories. Amongst the many improvements made in the "Angold" lamp since it was first put on the market, special attention is directed to the single carbon type. Many makers have lately discarded the use of rubber pads for brakes and clutches of their lamps, but the G.E. Co. have decided to adhere to the principle of the rubber brake, and have patented an arrangement for compensating the wear of the rubber and at the same time getting an absolutely constant feed. To do this a brake drum is employed which carries a band with rubber pads, one end of which is attached to a pulley controlled by a spiral spring in tension and the other hooked on to the rocking frame controlled by the two cores. The tension of the spring takes up any slack of the band as well any slack caused by the wear of the rubber pads, and this keeps the brake in action. This type of lamp has a good working action, and the working parts are made



"Angold" Enclosed Double-arc Lamp.

as lightly as possible, which ensures steady working with minimum of line resistance. Owing to the improvement made in the dash-pot action, the makers claim to get a steady strike with as little as 7½ per cent. loss in line resistance. The carbon holders are on the ball and socket principle, so that they can be brought into line and afterwards clamped up, when they remain a fixture. This type of lamp can also be supplied for reflection purposes, the only difference in the design being that the poles are reversed, so that the bottom carbon becomes the positive, thus throwing most of the light upwards. The mechanism is above the arc, and does not, therefore, get clogged with carbon dust. The possibility of short-circuits is also done away with.

Some small pattern enclosed-type lamps are listed such as are widely used for shop lighting purposes. They are said to burn well in series, and give a minimum carbon deposit on the inner globe. The line resistance, which is supplied fixed inside the lamps, does not require adjusting. The over-all length of the lamps is only 2 ft.

Up to a short time ago, the G.E. Co. had been supplying these lamps of the open type only, but in the list now before us we find prices of the new pattern "Angold" enclosed-type, double-arc lamp. This lamp, which we illustrate, is specially designed to meet the demand for a more efficient method of lighting from a single point when the circuit is from 200 to 250 volts. Each lamp has two arcs in the one globe, which burn in series; the same current gives double the amount of light without consuming more energy in the line resistance than is required to keep the lamp steady. Shunt coils are dispensed with by the use of special apparatus for striking and keeping the arcs of even length. This same apparatus also ensures that one carbon cannot be gripped before the other, and when once the carbons are clutched, they are moved up and down at the same rate.

Another item listed is a new and improved arc lamp for photo-

process work, for which it is claimed that the light is constant, and the correct exposure of negatives and prints can be gauged exactly. To this lamp can be fixed, if desired, a specially designed stand on which printing frames can be supported. The total capacity of this stand is 16 whole-plate printing frames, and they can be ranged any distance from the arc, and at any required height or angle. The supports of the lamp are insulated so that the stand can be used without any possibility of a shock.

In this list are also given particulars of the "Angold" automatic suspension gear and contact device. This gear has been used with great success by several borough councils and municipal bodies, and is especially constructed for automatically holding the lamp when suspended, and taking the strain off the steel wire. The crown of the lamp has an insulated plug mounted on it, which is provided with two spring-controlled catches. The normal position is horizontal. When the lamp is drawn up by the winch inside the posts, these catches first strike against the bell mouth of the socket, and are depressed inside the plug until the first increased diameter inside the socket is reached, when they open out and support the weight of the lamp on the ledge. This relieves the suspension wire of all strain. When it is required to lower the lamp, it is first pulled a little higher until the catches reach the second increased diameter of the socket; here they open out horizontally, and when the winch is released the weight of the lamp is thrown on to the suspension wire, and it can be wound down to the required position for trimming, &c.

It is hardly necessary to mention that the G.E. Co. makes carbons for these lamps at Witton.

Lamp-testing Wattmeter.

In fig. 1 we illustrate Messrs. Everett, Edgcumbe & Co.'s new lamp testing wattmeter, which shows at a glance the actual watts consumed by a lamp. This firm's lamp-testing ammeter being well known, no special description of the wattmeter is required. It is only necessary to insert the adaptor in any fitting, when on placing a lamp in the holder of the instrument, it will light up and the pointer will indicate the power consumed. Being a true watt-meter, all variations in the voltage of supply are accurately taken into account (which was, of course, not the case with the lamp-testing ammeter). The instrument is accurate with a direct or alternating current of any frequency, and, moreover, can be used to measure the power consumed by any other apparatus, such as small fan-motors, for example. The range which is found to be most generally useful, is from 0—130 watts, but any other range can be supplied if required.

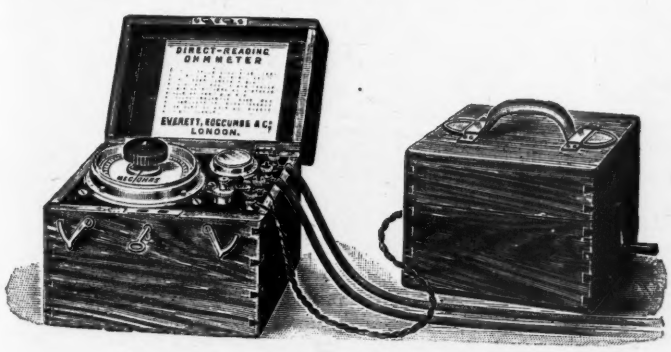


Fig. 1.—New Insulation Testing Set.

Fig. 2.—Lamp-testing Wattmeter.

A New Insulation Testing Set.

The accompanying illustration shows the new ohmmeter and generator of Messrs. Everett, Edgcumbe & Co. The chief advantages claimed for this set are that it is direct-reading, has an extremely open scale (about 12 in. long) so that accurate readings are possible throughout the entire range, the indications are independent of the testing voltage, and are unaffected by the strongest magnetic fields, so that it can be used close to dynamos or motors; further, it is compact and light. The set works on the Wheatstone bridge principle, but is so constructed that the insulation is read off directly on the dial, no plugs or switches being employed.

For ordinary insulation testing, the set can be used to read from 10,000 ohms to 20 or 50 megohms, while for mains testing an additional range can be added, so that measurements up to, say, 200 megohms can be made. For the latter purpose, the set is very handy, as the ordinary generator can be used with it instead of a cumbersome and messy portable battery; moreover, extreme accuracy is attainable, and no calculation is necessary, to say nothing of the fact that there are no plugs to get lost, or magnets to be adjusted.

So successful has been the insulation set, that Messrs. Everett, Edgcumbe & Co. have adapted it to copper resistance measurements; in fact, a complete set can be obtained 8½ × 6½ × 6 in., by means of which resistances of from one-tenth of an ohm up to 200 megohms can be measured without any alteration of connections, or, in fact, any manipulation whatever. Either a generator or a battery can be used with this set, or, of course, current from the supply mains. For the copper resistances, a few Leclanché cells are all that are required.

Lundberg's Accessories.

Mr. A. P. Lundberg, of Pioneer Electrical Works, Liverpool Road, N., in his new catalogue of electric light accessories, includes a number of interesting novelties, a few of which we select for description. Fig. 3 shows a patent locked cover which is adaptable to "Pivot" and "Century" switches. It forms a neat and effective method of locking covers of these switches to their bases to prevent unauthorised persons from removing same and tampering with the working parts. The principle can be applied either to fluted or to plain polished brass covers or plain porcelain covers. Figs. 4 and 5 illustrate the "Capstan" step-by-step switch, as supplied to the London County Council for asylum installations for series parallel circuits. Both lamp circuits are quite dead when the switch is in the "off" position; efficient rubbing spring contacts are provided. In turning the thumb key to the right, the switch is locked in each of the various "on" positions successively—(1) series, (2) parallel, by means of an escapement ratchet wheel and pawl acting against the controlling spring. A movement of the key to the left releases the contact plate from (2) position into (1) again, a further movement breaking the circuit. The controlling

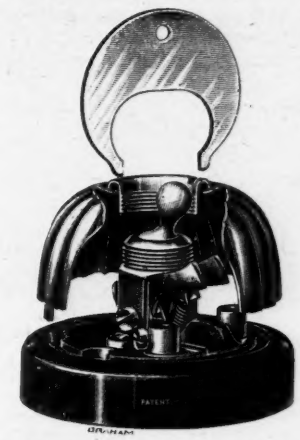


Fig. 3.—Locked Cover for Switches.

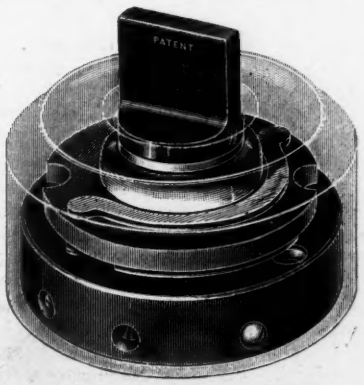


Fig. 4.—Capstan Step-by-step Switch.

spring tends to hold the contact arm in the "off" position, so that quick movements are obtained when thumb key is turned to the left. The principle of the switch could no doubt be employed to meet several requirements—*e.g.* (*a*) For controlling lamps in an

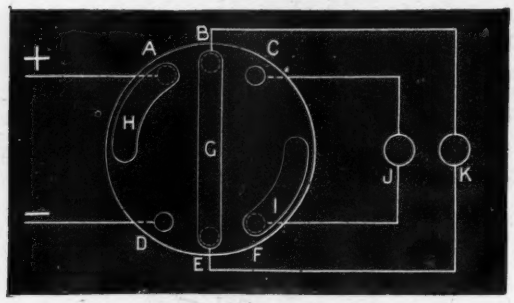


Fig. 5.—Diagram of Connections showing Capstan Switch in the "Off" Position.

electrolier from one upwards; (*b*) as a regulating switch adding resistance at each step, and *vice versâ*; (*c*) as a two-way switch with "off" position between the two ways.

The diagram shows the switch in its "off" position; a 30° movement of the thumb key to the right brings the lamps into series with each other, C and D being bridged by the cross-piece G, A and B by

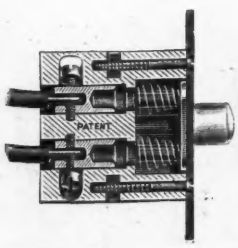


Fig. .
"Simplex" Door Contact.

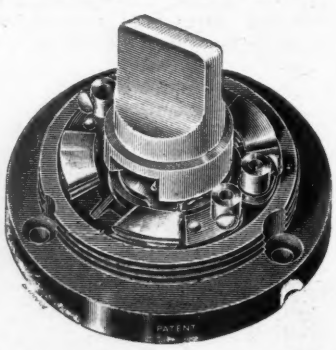


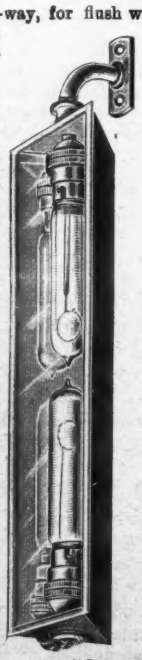
Fig. 7.
Impulse Two-way Switch.

segment piece H, E and F by segment piece I. A further 30° movement to the right brings the lamps into parallel with each other, A, B and C, D, E and F being bridged by the segment pieces H and I respectively. The cross-piece G forms no part of the circuit in this position. The switch allows a double-break action when passing from parallel to series, and a quadruple break when passing from series to "off."

The "Pivot" switches, single-way and two-way, for flush work are fitted (with small base) in a brass box asbestos lined and ebonite bushed and a number of these are illustrated in the list.

The "Simplex" door contact for lavatory lighting, &c., shown in section in fig. 6, is now made in porcelain as well as fibre. The terminals are well shielded; the circuit is completed when the plunger is pushed home.

In fig. 7 we illustrate the "Impulse" two-way switch, which has been designed specially for two-way wiring for corridors, staircases, &c. No current passes through the movable centre, and the action is claimed to be very rapid and effectual; it affords a quick double-break from each "way," independent of operator. Effective spring contact jaws are fitted.



nlite" Reflectors

"Sunlite" Reflectors.

The special angles of the reflecting surfaces of the "Sunlite" Patent Registered Reflector have been determined upon after much thought and experiment, and are calculated upon scientific lines to give the utmost possible radiation, diffusion, and concentration, with minimum consumption of electricity.

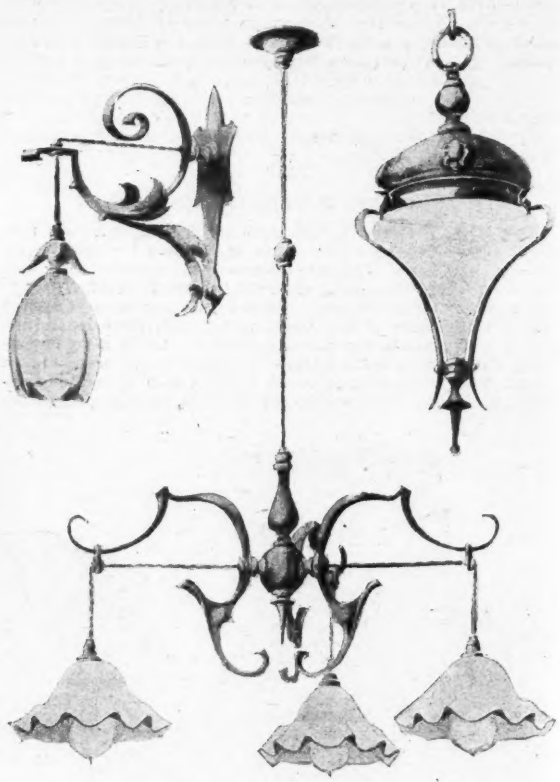
At present the reflector is made in three sizes, the smallest presenting when made in any length, practically a thin line of light of great power and brilliancy. One of its great features is its great adaptability for any conceivable position where reflected light is required. The angle principle referred to, combined with the Sun concealed method of wiring, applies equally well for one light as for a hundred in one continuous stretch. The system was introduced a few months ago, and for picture] lighting it has been especially successful.

An illustrated list just issued by the Sun Electrical Co., of Charing Cross Road, W.C., shows a few of the various ways in which it can be used. It has been supplied for concealed inside shop window lighting, cornice and ceiling work, outside bracket reflectors, facia lighting, &c. The makers use standard articles such as are in everyday use, in the way of lampholders and lamps, so that when lamps break, replacement can be easily made.

The "Sunlite" reflector is lined with a special heat-resisting mirror plate. It is kept in position by nickelled beading, not cemented as in the usual practice, thus avoiding the necessity of wasting time in cleaning, which has to be done in the case of metal reflectors. By the small recess which is fixed on one of the outer sides of the reflector, and by making the front section of each division detachable, the wiring is easily effected, and there is no danger of damage to exposed wires.

Some New Fittings.

The Electrical Fittings Co., of 38, Conduit Street, W., have laid down a special plant at their Birmingham works for the more



The E.F.Co.'s New Fittings.

economical manufacture of their artistic electric light fittings. A supplementary catalogue has lately been issued showing a few of the latest designs they have brought out, and we have selected the accompanying three as giving a good idea of the whole. Their showroom contains an extensive exhibition of different styles of fittings. Those which we illustrate are supplied either in polished brass, oxidised copper or silver.

OUR LEGAL QUERY COLUMN.

[*Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.*]

"Works Department" writes:—"In one or two numbers of your valuable paper you published the result of an action (legal), entered by a supply company, whom I will term 'A,' to prohibit another supply company 'B,' from supplying current to a consumer 'C,' whose premises were situated within the area granted to 'A,' although the cables entered the premises at a place within the area of 'B.' Will you kindly send me the numbers containing this case."

*** We do not at the moment recall the case to which our correspondent refers. It is clear, however, that it is illegal for an electric supply company to supply energy to consumers outside its area. Thus by Sec. 4 of the Schedule to the Electric Lighting (Clauses) Act, 1899, it is provided that the undertakers shall not at any time after the commencement of the special order, supply energy, or erect, or lay down any electric lines or works beyond the

area of supply otherwise than under the authority of Parliament, or under a licence granted by the Board of Trade under the principal Act. If this section is contravened, the Board of Trade may revoke the special order on such terms as they think just. So far as we are aware, no case under this section has arisen in connection with the supply of electricity, but our correspondent may derive assistance from the case of the Gas Light and Coke Co., *v.* South Metropolitan Gas Co., 62 L T. 126, which was decided in connection with the supply of gas By Sec 6 of the Metropolis Gas Act, 1860, the limits of each gas company then supplying the metropolis were defined, and in the result each company enjoyed a practical monopoly in its own district. One company, at the request of a railway company, placed a meter on a part of a railway station lying within the company's limits, and through it supplied gas to other parts of the premises situated outside the company's limits and within the limits of another company. The Court of Appeal held this to be lawful, on the ground that the sale and delivery of the gas took place at the meter; but the House of Lords reversed this decision, holding that the gas was supplied where it was consumed, and therefore that the company was transgressing its authorised limits.

Inasmuch as the law relating to electricity is founded on the law relating to the supply of gas, this decision is of the greatest importance to electrical supply companies.

LEGAL.

Greenhouse *v.* South Lancashire Electric Traction and Power Co., Ltd.

In the Lancashire Chancery Court last week plaintiff made a motion against the defendant company and the trustee of a debenture trust deed, for an injunction to restrain the defendants or any of their officers or servants or agents from acting upon, carrying out, or giving effect to, extraordinary resolutions purporting to have been passed at a meeting of the debenture stock-holders of the defendant company, held on October 7th last, and from treating the resolutions as having been validly carried. Mr. Grant, who appeared for the plaintiff, a debenture-holder in the defendant company, said the company proposed to create £600,000 mortgage debentures and place them in front of the present mortgage debentures, and the question was whether a majority of the debenture-holders could carry that against a minority, the effect being to make the first debenture-holders second debenture-holders. The Vice-Chancellor directed that the question in dispute should be tried on November 16th next. Mr. Hughes, K.C., for the company, stated that 80 per cent. in value of the debenture-holders were in favour of the proposal.

CORRESPONDENCE.

The Central Station Battery.

On reading the letter in the Electrical Review of the 30th ult., I can quite understand why the writer hides behind a pseudonym, also why he chooses the word "Electrolyte"—it is a most suitable name judging by the contents of his letter.

I have read the first two paragraphs of this letter over and over again, and I must be very dense, as I quite fail to see anything in them. Is it something funny? Again, why does the writer pride himself so unjustly upon being such an "observant reader," because he sees in the Electrical Review :—

1. What nobody who reads that paper ever misses.
2. What was public property before the appearance of the Review of September 18th.
3. Last, but not least, what was and is inserted on every advertisement and pamphlet relating to my cell recorder, *i.e.*, "Abraham's patent cell recorder."

Nobody who was blessed with ordinary intelligence would, to quote the words of "Electrolyte": "On reading his article, at once jump to the conclusion that they had only to buy one of his patent cell recorders . . . . and the battery would require no further attention." I am sorry "Electrolyte" has taken my article in this way. I wish he had read this as carefully as I have read the aforementioned first two paragraphs of his somewhat wandering letter! No wonder "Electrolyte" "is afraid that Mr. Abraham's article is calculated to do much more harm than good."

Let me remind "Electrolyte" that one object of my cell tester is to save time and labour. "Electrolyte" should arm himself with pencil, note book and voltmeter, and carefully take and write down the volts of a (say) 280 cell battery every week, perhaps at 3 a.m. on a cold winter morning, and he would then welcome my cell recorder, and say kinder things about it.

I must contradict "Electrolyte" when he says :—"That it is usual to take volt readings on the weekly overcharge day." This is *not* the case, *and, moreover, the volts of a battery should never be taken at the end of the weekly overcharge, but at the end of an ordinary charge*, for obvious reasons. For this reason, as I before stated, my cell recorder will save not only time but current, which would otherwise go to waste.

Towards the end of his remarkable epistle "Electrolyte" falls considerably "below the tops of the plates," so to speak, by the following statement :—"The way, however, to keep a battery in order is to do what Mr. Abraham evidently so contemptuously ignores. He says in his article that cells are '*just looked at to make sure they are gassing.*' This, one might say, is the whole secret of the business, &c."

Now, what I really said in my article was : "In too many cases are the volts of a battery taken here and there and *the other just looked at to make sure they are gassing*," which is quite a different thing. However, that does not matter very much so long as I assure "Electrolyte" (whoever he may be) that often a *defective* cell—that is to say, a cell which needs attention—will, under certain conditions, gas equally with its healthy brethren; and that cells "just looked at to make sure they are gassing," and nothing else, will come to an untimely end.

"Last, but not least," "Electrolyte" goes on to remark, "do not let cells gas too long." Here, at least, we have a sentence which backs up the use of my cell recorder, and which contradicts most of his letter.

Personally, I should be very sorry indeed to follow "Electrolyte's" advice as to the "way to keep a battery in order," and I should like to add that "my battery" is as far from the scrap heap as any battery in the country. Nor is my cell recorder likely to get there. In conclusion, while thanking "Electrolyte" for his amusing letter, I would like to advise him to get up his subject a little better before again adopting the *rôle* of critic, when perhaps he will be able to give his name, and not hide his light under a bushel.

Arthur J. Abraham.

Partick, *November 1st*, 1903.

An American Discovery.

We have in recent years been informed from time to time by American engineers who are located on this side, of our inability to build engines for electric traction work, but it is still more amazing to read in the *Daily Express* of October 26th of a discovery reported to have been made by Mr. Chapman, the general manager and engineer to Mr. Yerkes, regarding our methods of chimney construction.

In the article referred to we are told that "British workmen will not build chimneys without scaffolding erected on both sides, and are not accustomed to work from the inside of a chimney," all this being given as a reason for employing alien labour on the stacks now being built at the Chelsea generating station. We are also told that our workmen frequently strike for higher wages every 10 ft. they go up.

Now, Sir, as an engineer who has designed and superintended the building of numerous chimneys, varying in height from 70 to 250 ft., may I say that I have only seen scaffolding on the very smallest, but in all other cases the work has been done entirely from the inside, and having followed it from day to day, I am in a position to prove that British workmen can and will do it, and as for strikes, I have never experienced such a difficulty.

As an instance of our inability, we are referred to a chimney being built at Wandsworth which I have not yet seen, but I have a recollection of seeing a chimney in course of construction on the banks of the Regent's Canal, near the New North Road, last year, without any external scaffolding, and I am inclined to think British workmen were employed on that work; and I could relate numerous other instances, such as Tennant's chimney at Glasgow, another at Greenhithe, both over 300 ft. high, and many others 200 ft. high, all built from the inside.

In strange contrast, I find, on looking in *Power* for March, 1899, several illustrations of an American chimney

at the 96th Street Traction Plant, New York, the height of which is 350 ft., and find it was scaffolded on the exterior for half its height at least, and I have been informed that this particular chimney and its foundations were so well designed that the whole sunk nearly 4 ft. Have any of our British engineers had such an experience as this?

I enclose a copy of the paper containing this article for your perusal.

Arcturus.

Steam Turbo-Generating Plants.

In your issue of October 30th, you print an abstract of a paper by Mr. G. Wilkinson on steam turbo-electric generating plants. The author gives in parallel columns the supposed performance of a 1,400-KW. set with triple-expansion reciprocating engines recently erected by us at the Leeds central station, and that of a steam turbine at the Newcastle and District Electric Lighting Co.'s works.

We say supposed performance, because the actual result for our set was 19·49 lbs. per KW., and not 19·9 lbs., and this again was water measured into the boilers, and includes boiler and steam pipe losses, the actual engine consumption measured at the hotwell (as, no doubt, in the case of the steam turbine), being only 18·7 lbs. per KW.

The turbine was, moreover, running at 237° F. superheat, whilst we had about 71° F., which, of course, makes an enormous difference. With triple-expansion engines of 500 B.H.P., running at 25·4 in. vacuum, and with 200° F. superheat, we have obtained 16·1 lbs. per KW., and with 237° F. superheat, we should be prepared to guarantee for the Leeds engine, something under 16 lbs. per KW., as against the 17·73 shown for the 1,750-H.P. turbine.

Immediately preceding the above comparison, figures are given for a Sulzer-Kolben plant with *saturated* steam and 24 *in. vacuum*, and a Parsons turbo-generator with 100° *superheat* and 28 *in. vacuum*. Such comparisons are, of course, worthless and misleading. The 4 in. difference in vacuum at 4 per cent. per inch given in the paper means 16 per cent. to the turbine, and the 100° of superheat another 12 per cent., as stated, so that after due allowance has been made for the vacuum and superheat, the result for the turbine comes out worse, and not better, than the other.

Again, the tests of the 500-KW. turbo-alternator at the Cambridge electricity works, after 12 months' running, are made with 9 lbs. higher steam pressure, and 3·3 in. better vacuum than on the original test, when 24·1 lbs. per kilowatt was registered. At the 4 per cent. per inch the vacuum is good for 13·2 per cent., and the consumption should have come down to 20·92 lbs., or allowing for the working of pumps, say, 21·5 lbs., but instead of this, it goes up to 25 lbs., and yet the conclusion is come to that the trials show that there has been no deterioration due to wear.

It is, in our opinion, regrettable that advocates of steam turbines should make such misleading statements. At the present date the turbines of Mr. Parsons's make or design are the only ones having any claim to be considered beyond the experimental stage, and the latest tables published in the electrical papers giving the figures for 12 months' running, show that these turbines are very far behind reciprocating engines in economy in actual central station work, though the results with them on the test plate were supposed to be good.

The present booming of the turbine will surely result in a serious set back when experience has been purchased at a heavy cost by the users.

Belliss & Morcom, Ltd.,
ALFRED MORCOM, *Managing Director.*

Birmingham, *November 3rd*, 1903.

P.S.—It should always be borne in mind that the cost of obtaining the high vacuum necessary for efficiency with steam turbines may become a very formidable item in the majority of inland stations.

Waste of Energy in Tendering.

Mr. Bloemendal, in your last issue, remarks that the question of waste of time and money in uselessly tendering to fantastic specifications has the undivided attention of all electrical, manufacturing and contracting firms. I cannot think that, if this were the case, matters would be in their present condition.

All persons whose business it is to peruse the specifications, and tender for contracts with municipal and other public bodies, will, I feel sure, agree with me in attributing objectionable specifications to the following three causes :—

First, ignorance on the part of the consulting engineers, or, in the case of electrical contracts, of the (*sic*) surveyor or town clerk.

Second, bumptiousness and an exaggerated idea of their own importance on the part of the above persons.

Third, *sub rosa* specifications drawn up in such a manner as to make it impossible for any but a certain firm to tender exactly in accordance with the specification.

This is particularly applicable to meter contracts. How often is some insignificant detail made a condition of the contract, in order to keep off all but the makers of a certain meter, which is preferred, let us hope (though very feebly), from disinterested motives.

To return to the main question, co-operation on the part of the firm concerned, is, of course, the only solution. Not, however, in the manner mentioned in Mr. Bloemendal's letter. An alternative method would be for, say, 50 of our leading manufacturing and contracting firms to unite, in appointing an automatically-changed committee, to examine all specifications, and blackball those of an improper or undesirable character. This would do a vast amount of good to the industry at large, not only by saving contractors a great deal of trouble, but by forcing municipalities to employ persons competent to draw up specifications which will bring tenders from firms capable of properly fulfilling them.

R. A.

I, too, have read with considerable interest, Mr. E. K. Scott's article on this matter, and heartily concur with Mr. Arthur Bloemendal that something ought to be done to mitigate the heartless waste of time and money, which is not only becoming a drag on our progress, but as Mr. Scott justly points out, a loss to the profession.

I would go even further, and add that it is a decided loss to the country; as, for instance, if the brains, experience, and energy at present thrown away in fruitless work of this kind were given to other and more profitable employment, it would considerably improve our economy in production. Nor is this latter of lesser importance, considering the strength of argument relating to this want, which has followed in the train of fiscal controversy.

When a dozen specifications are sent to as many contractors for a particular contract, the value of which may not exceed £250, and each contractor, in the process of compiling his estimate, must obtain minor estimates from five or six different manufacturers, you get quite a mild example of what takes place every day. The contractor, and, in turn, the manufacturer, are losing patience at this kind of thing, and justly so.

I cannot but think that the remedy must lie with the consulting engineer, who, if alive to his own interests, would, no doubt, willingly respond to a united appeal; and I also feel sure that, in the event of the consulting engineer being equally favourable to the 12 firms, the members of such firms would infinitely prefer to be one of four selected to compete on three different occasions rather than be placed in the ridiculous position of one in twelve.

For such united appeal we must look in a great measure to the manufacturers' and contractors' associations, with the hope that the series of papers to be read at the forthcoming meetings may form a good augury, in that some of the subjects are more or less akin to this question.

Many thanks are due to Mr. E. K. Scott for so opportunely bringing forth his views, which must appeal to all self-respecting and patriotic members of the profession, and it is the duty of one and all to give his remarks their serious attention and united support.

The sooner a definite understanding is arrived at, the better it will be for the manufacturer, the contractor, the consulting engineer and the country.

Duncan Watson, A.M.I.E.E.,
Mem.Soc.Eng.

London, W.C., *November 3rd*, 1903.

Electric Pumping for Mines Drainage.

In your issue of October 23rd you refer to electric pumps being put in and used by the South Staffordshire Mines Drainage Commissioners.

Living in this district, I know the probable number of pits at work and the number closed; the latter, I am sorry to say, outnumber those that are at work by a large majority.

If the Commissioners pump so much water by their pumping engines in the various districts, does it clear the pits on the lower benches? Does not the water they pump go into the canals? The canal company's pumping engines keep up the level of the canals. Where does the leakage from the canals go to? Is it not a well-known fact that if they pumped over a certain amount in a certain time, the property in the locality would cave in?

If it is proved that electric pumping is cheaper than steam pumping, then let the mines drainage steam pumping engines stop, and let each colliery have its own motor, or, where there are several pits on the same level, let the masters combine and pay so much between them for electric pumping. They would then pump in the vicinity of the coal and not, as at present, with a few engines per 100 sq. miles. Pumping would then be done at the actual place required.

There are dozens of pits in the district where coal is known to abound in thousands of tons, and not such a great distance from the surface, but which, in my estimation, can never be got until the Mines Drainage alter their methods and charges. I believe that with electric pumping (individual) best thick coal could be got and delivered at the door for 6s. a ton.

If the rubbish from one pit or pits was tipped down the others which were known to be actually worked out, there would not require so much pumping. Property would increase in value, and trees and plants could be planted on natural soil, beautifying and increasing the value of the land.

C.

[A reply to our correspondent would involve a dissertation on the whole matter of mines drainage, together with a defence of the existence and methods of the Drainage Commissioners, and this, however interesting, would be somewhat out of place in this journal.

We drew attention in our note to the latest development in the use of electricity, pointing out especially how many advantages it had over the use of steam pumps, but we had no intention of raising a discussion on the question of the comparative efficiency of individual or organised management of the pumping operations, or on the many other technical and commercial points raised by our correspondent.

We may say, however, that it is always open to any mine owner to make his own arrangements for keeping his workings clear of water, and in some cases this has proved advantageous. Some, again, do part of their pumping, and are helped by the Commissioners.

Only last Saturday permission was given by the mortgagees to the Commissioners to proceed with their engineer's scheme for the further unwatering of the Tipton district, at an estimated cost of £68,000. If this scheme, which makes use of electricity, Mond gas and steam, fails, then both the Mines Drainage Commission and the Tipton coalfield will be hopelessly submerged.

It behoves gentlemen like "C" to bury their differences of opinion and to work for the success of this last and brave effort.—Eds. Elec. Rev.]

Single-Phase Alternating Current Motors.

Notwithstanding anything that Mr. Schüler has said in his letter in your issue of the 30th ult., I do not see any reason for correcting the statement I made on October 23rd. I was not, at the time, in a position to deal with anything beyond the performance of the motor in question, not having at that time seen Mr. Schüler's specification.

I take it that the novel features involved are high starting torque with a low starting current in combination with the total absence of sparking during that performance.

This had already been achieved by me, and the motor I had designed possessed, in addition, the advantage of unity as power factor, and offered the possibility of varying the speed over a very great range.

Mr. Schüler now deals with the question of patents, and I am quite willing to follow his lead, and at the same time set his mind at rest as regards his patent making any of mine null and void. It may be of interest to him to learn that I had at one time considered the advisability of claiming what forms the substance of his patent, viz., the use in a single-phase motor of an ordinary direct current winding connected to a commutator and to slip rings, such motor being started as a repulsion motor in the first stage, and run up to speed, when required, with the help of resistances between the slip rings, as an induction motor. I would have claimed such an arrangement simply for the sake of covering as much ground as possible, and not with any intention of using it in my motors, as I have found during my experiments that this scheme possesses very serious disadvantages. Having instituted a careful search, however, I came to the conclusion that in view of a number of previous patents and publications, also in view of the state of our general knowledge, it would be difficult for me to uphold any such claim. The matter was finally settled for me when I was credibly informed that this very disposition had been in use for the last two or three years at the Central Technical College in London. In the meantime I had developed more useful windings and also an efficient means of preventing sparking, the specification for which will be published shortly.

No device seems to be included in Mr. Schüler's arrangements for meeting this difficulty, and although it may not be very serious with small machines, with large ones it becomes very troublesome.

Mr. Schüler has, no doubt, also made a search before applying for his patent, and has evidently come to an opinion differing from mine. Should he prove to be right, he is quite welcome to reap all the benefit that he can from his better judgment.

Val. A. Fynn.

Bradford, *November 3rd*, 1903.

Electric Welding.

Will any reader kindly inform me as to the best method or system to use to electrically weld sheet-steel drums?

Welder.

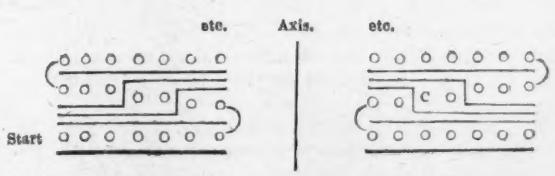
Jointless Section Coils.

With regard to Mr. Leslie Miller's letter in your last issue, may I claim a small portion of your valuable space in order to rectify some of Mr. Miller's statements?

The "jointless" winding of the secondaries of induction coils, though possibly not described or patented in this country, is by no means new, such system having been employed by a well-known Continental firm for a period of over 20 years, and coils built by this firm have been largely imported into England during at least 12 years. Incidentally, it may be well to mention that no such makeshift method as string or thread fastening is resorted to.

Moreover, a patent (Swiss) was granted to a Swiss firm for a similar and even better system about three years ago, and this system has been fully described in some Continental publications. As it seems to follow up the idea underlying Mr. Miller's method to its fullest possibility, I annex a diagrammatic sketch.

It will be seen that by this means the thickness of the insulation increases almost proportionally with the potential



difference between the several portions of the winding, and that without materially affecting the utilisation of the winding space.

E

The machine which carries out this winding has made it possible to produce coils on this principle as cheaply as ordinary coils.

Mr. Miller rather overstates his magnanimity in giving me an opportunity to oppose his patent! The fact is, that he drew my attention to a statement in one of my advertisements, which mentions a certain number of sections in the secondary, and since neither this particular detail nor the absence of joints in the secondary—as apart from Mr. Miller's design of his special machine for winding—can form the subject of a valid patent, I did not go to the trouble of opposing his patent.

So long as the English patent is granted without an exhaustive official search on the part of the Patent Office for anticipations, it is a matter of great importance to the inventor to assure himself that the foreign patent records, as well as those of this country, do not contain the subject matter of his claim.

A. W. Isenthal.

London, *November 2nd*, 1903.

Wireless Telegraphy.

I note your comments on Mr. Bentley's letter in the last issue of your paper.

Practical experience of wireless telegraphy is confined to few persons, and, so far as the most advanced system is concerned, is restricted almost entirely to the staff of our company. It is not, therefore, surprising that a good deal of misapprehension and ignorance should exist generally as to the possibilities and limitations of this system of telegraphy.

A very superficial examination, however, of inherent probabilities should lead any intelligent person to conclude that the pretensions to syntony are not shown to be unfounded, because under the circumstances described at the Yacht Races interference resulted. To pretend that under no circumstances can interference take place by other wireless telegraph instruments, or by apparatus installed for the special purpose of causing interference, would be obviously ridiculous.

In order that a message may be received on a tuned instrument, waves of a certain length must be transmitted from an instrument within range. It seems almost too obvious to require to be stated that, if a second transmitter within range begins to work with the same wave-length, there will be received at the receiving station messages from both instruments, with resultant confusion. Nothing has ever been said or written by Mr. Marconi, or by the responsible representatives of this company, to the contrary; nor do the quotations you give from statements attributed to Mr. Marconi in any way support the contention that he has ever pretended that under no circumstances could interference result. A moment's intelligent consideration would show that, for the reasons referred to above, such a contention would be ridiculous. Judging, however, from the quotations you give, and the deductions you draw from them, you appear to think that, because *two similarly tuned* circuits cannot be worked simultaneously within range of each other, therefore our contention is disproved that it is practicable to work *two differently tuned* circuits within range of each other.

The claims made by Mr. Marconi with regard to syntony—claims which have been established by independent experts of the highest standing, notably by naval officers, who have had a special interest in and special opportunities for studying this question—are not that under no conceivable circumstances can messages sent between two stations be intercepted by another station, or that under no circumstances can they be interrupted. To make such a claim would be to attribute to wireless telegraphy an immunity from interference which certainly cannot be claimed for any other system of telegraphy.

The claim made by Mr. Marconi is that it is practicable to work simultaneously many differently tuned wireless telegraph circuits without interference between them, or interception of messages. Nor is it of special importance—although, of course, it would be, in the present stage of legislation in the matter, convenient to secure immunity from interference and interception under all circumstances. What is of importance is that it should be possible, in a properly organised system, to work many circuits simultaneously without interference and interception.

In this respect wireless telegraphy is in no worse, and perhaps in a slightly better position, than ordinary telegraphy. It is a matter of common knowledge that many legitimate applications of electricity may, and have, interfered very seriously with land telegraphs and submarine cables. It would, however, be foolish to condemn submarine cable telegraphy and land telegraphy, and to describe, for example, the system of cables landing at the Cape as an absolute failure, because at one time their working was most seriously disturbed by the electric trams. What we are concerned to know is whether it is practicable to carry on in the vicinity of land telegraph systems and of the landing points of submarine cables, without disturbance to them, an application of electricity of great value to the community—viz., electric traction. It is a matter of common knowledge that the difficulty has been solved generally, and was solved in the particular instance quoted. By the adoption of suitable precautions, it has been found practicable to continue to work the submarine cables and at the same time to run the Cape electric trams.

Examples might be multiplied. The telephone lines of rival systems may be run in such a fashion that persons using one system cannot secure the secrecy of their messages; but the question is not whether it is possible for the messages to be intercepted, but whether it is possible to devise a system of telephony in connection with which such interception does not take place.

We do not say that our wireless telegraph system cannot be interfered with, or that the messages cannot, under any circumstances, be intercepted. We merely claim that with a properly organised system it is practicable to carry on, within a small area, simultaneously, many different communications.

The experiments recently made with our high power station at Poldhu and the *Lucania*, when messages were transmitted daily over distances ranging from about 350 miles to about 1,500 miles (mid-ocean) are evidence in point. We do not claim that no station can under any circumstances be interfered with by Poldhu, but merely that it is practicable to work this high power station, and at the same time work the ordinary connections between ships at sea within range of the big power station and between these ships and shore stations at a very short distance from Poldhu station.

It is natural that the public, to whom wireless telegraphy appeals as something almost incredibly marvellous, should be sceptical as to the claims put forward by the company which is itself working the patents. But I may point out that these claims as to syntony—such claims as we make, and as Mr. Marconi has made—have been clearly established in the presence of independent experts acting for their Governments, and other parties with whom we have been contracting.

The official narrative of the combined manœuvres of the Mediterranean, Channel and Cruiser Squadrons in 1902, which you recommend Mr. Bentley to read, has no bearing whatever upon the claim made by our company with regard to syntony. No ship of those squadrons carried our tuned apparatus, the apparatus on board being untuned apparatus supplied by us to the Admiralty in 1900.

I am unable to judge whether your strictures will be regarded by your readers as fair and moderate. It is important, however, that if they are to arrive at a just conclusion, they should have the facts before them—what we claim, with what apparatus, and what evidence there is of the truth of our contentions. We do not claim that our apparatus cannot be interfered with under any circumstances. We claim that we can organise a system of many circuits, working within a small area, which will not interfere with each other. We do not regard as evidence of the failure of our syntonised apparatus the fact that there was confusion between the squadrons using our unsyntonised apparatus.

I say, unhesitatingly, that in some respects we are in a better, and in all respects, in as good a position, as all ordinary systems of telegraphy. The persons concerned with submarine cables and land telegraph lines have to consider not whether in any circumstances it is practicable to upset the lines, but whether it is practicable to organise a service which will not be interfered with, given the observation of certain precautions, both by themselves and by other persons.

The common retort of people who examine the subject

superficially—that anyone who chooses to work a wireless telegraph station may interfere with an organised service—does not seem to me to be serious criticism against the utility of wireless telegraphy. A similar statement might be made with regard to land telegraphy and telephony in our towns. If anyone were allowed to run at will all over a given area wires carrying electric currents, serious disturbances would result; and even where the running of such wires has been restricted to certain persons, and where all have been concerned solely with legitimate services, disturbance has resulted, and special legislation has had to be enacted.

At the Yacht Races there was malicious interference, that is, apparatus worked simply for the purpose of preventing the transmission of certain persons' messages; and there may also have been interference from genuine attempts by different persons to transmit messages. Having regard to the circumstances, the words "failure" and "success" are not applicable. It would be a misuse of words, in connection with ordinary telegraphy, to denounce as a "failure" the transmission of only 70 per cent. of the messages handed in, if, for example, an electric traction system in the neighbourhood was sending heavy currents through the earth, or there were allowed close to the lines of the telegraph company in question other telegraph lines in connection with which certain specific arrangements had not been made with the express purpose of preventing interference with the neighbouring circuits.

Marconi's Wireless Telegraph Co., Ltd.,
H. Cuthbert Hall, *Managing Director.*

London, *November 3rd*, 1903.

[Our reply last week, together with our original article, are, we think, a sufficient answer to such arguments as can be deduced from this letter of Mr. Cuthbert Hall. We are glad to note that the Marconi Co. now admit the limitations of syntony.—Eds. Elec. Rev.]

[A correspondent wishes to know who supplied the electric light fittings for the House of Lords and House of Commons.]

BUSINESS NOTES.

Stellite Telephones. — The Electric and Ordnance Accessories Co., Ltd., have issued a 12-page leaflet dealing with the Stellite central battery exchange system of telephony. A full description is given in the pamphlet, but we may draw attention to some of the leading points. The system has only one central battery, and a great saving is thus effected in the initial outlay and also in maintenance charges. The power may be obtained either from primary or secondary batteries, and for large installations a special motor-generator is supplied which has three windings on one armature where it is desired that the ringing current may be alternating. If direct current is used for ringing as well as speaking, the makers generally recommend that a battery of Leclanché cells or of accumulators be used. As it is not necessary to use any battery or box at each station, the company have been able to design instruments which are neat and compact. They are arranged to be used either as wall or table sets, and the conversion is made without any addition of loose parts. The switchboard has been designed to combine all the latest improvements in telephony, whilst avoiding the complications. The calling and clearing indicators are all self-replacing, and being under cover are not likely to get out of order. It is claimed that absolute secrecy is obtained with this system, although, if desired, the switchboard can be arranged so that the operator can come into circuit at will. The company will send a copy of the list (No. B. 41) to any applicant.

Turbine Generators.—The British Schuckert Electric Co., Ltd., has received an order through Messrs. Willans & Robinson, of Rugby, for a 1,000-kw. continuous current generator for Messrs. R. & W. Watson's works at Linwood, N.B. The generator, which will be directly coupled to a steam turbine supplied by Messrs. Willans & Robinson, will generate a current of 4,000 amperes at 250 volts pressure, and will be sub-divided into two separate portions each of 500 kw. capacity placed in tandem upon the continuation of the turbine shaft.

Italy.—The firm of La Sociéta Italiana de Elettricita Siemens, of Milan, has changed its title by the addition of the word Schuckert. At the same time the capital has been increased to £20,000.

Electrical Wares Exported.

Week ending Nov. 4th, 1902.		Week ending Nov. 3rd, 1903.	
Alexandria	Value £21	Alexandria	Value £20
Auckland	6	Amsterdam	75
Bombay	798	Azores	500
Calcutta	1,362	Bombay	90
Cape Town	362	Buenos Ayres	157
,, Elec. cranes ..	10,400	,, Teleph. cable ..	1,050
Colombo	123	Calcutta	1,315
Copenhagen. Teleg. wire ..	49	,, Teleg. mat.	770
Durban	201	Cape Town	45
East London	1,113	Chinde	59
Fremantle	85	Delagoa Bay. Teleg. mat. ..	7,321
Gibraltar	89	Durban	250
Hamburg	125	,, Teleg. mat.	83
Hong Kong..	140	East London	977
Launceston	53	Fremantle	416
Madras	93	,, Teleg. mat.	225
Malta	145	Ghent	35
Melbourne	72	Gothenburg	15
,, Teleg. wire ..	2,505	Hamburg	36
Perth	863	Hong Kong. Teleg. mat. ..	51
Philadelphia	50	Kingston, Ontario	30
Port Elizabeth	256	Maceio	21
Progreso. Teleph. mat. ..	70	Madras	328
Rangoon	12	Melbourne	145
St. Petersburg	683	,, Teleg. cable.. ..	1,530
,, 7 cwt. teleg wire	—	Penang. Teleg. mat.	19
Shanghai	22	Perth	167
Stockholm. Teleg. wire ..	28	,, Teleg. mat.	60
Sydney	365	Port Elizabeth	432
,, Teleg. wire	113	,, Teleg. mat.	50
Trinidad	35	Port Said	68
Valparaiso	30	Rio de Janeiro	74
Wellington	315	St. Petersburg	400
Yokohama	107	,, Teleg. cable ..	115
		Shanghai	247
		Singapore. Teleg. mat. ..	776
		Stockholm. Teleg. mat. ..	19
		,, Teleg. wire ..	170
		Sydney	514
		Toronto	85
		Tripoli. Teleg. mat.	202
		Vancouver, B.C. Teleg. apps..	180
		Vera Cruz. Elec. cable.. ..	2,433
		Wellington	20
		,, Teleg. mat. ..	1,120
		Yokohama	207
		Zanzibar	20
Total ..	£20,671	Total ..	£23,522

Foreign Goods Transhipped.

Sydney. Elec. appliances	Value £60	Brussels. Elec. mat. ..	Value £80
		Fremantle. Elec. mat. ..	1,117
		Lisbon. Teleg. mat.	17
		Port Elizabeth. Elec. mat. ..	97
		Total ..	£1,311

Manganese Steel.—Messrs. Hadfield's Steel Foundry Co., Sheffield, have, during the past month, obtained the following new tramway contracts for points and crossings in their patent "Era" manganese steel:—Paisley Tramways, through Messrs. Murphy & Sons; King's Norton Tramways, through Messrs. Blackwell & Co., contractors; Scarborough Tramways, through Edmundson's Electricity Co. (all special junctions, &c., for this work are also being built by Messrs. Hadfield); Brighton Corporation Tramways, for extension lines, as recorded in our last issue (all previous work at Brighton has been in crucible cast-steel); Aston Manor Tramways, through Mr. G. Trentham, contractor; Edinburgh Tramways Co.; Liverpool Corporation Tramways for 12-ft. points, &c.; and Sheffield Corporation for 12-ft. points, &c.

Lamp Works for Mexico.—Large works for the manufacture of incandescent lamps are about to be established in Mexico.

Football.—Veritys' Athletic Club played their first away match on Saturday last at Bailey's Lane, Stamford Hill, against Ashby, and proved successful by 12 goals to nil. A feature of the game was the play of "V.'s" captain, W. M. Longhurst, who delighted the spectators with a grand shot from close on the half-way line which clean beat the home goalkeeper all the way. Next Saturday Veritys play the Peel Institute on the former's ground, Piper's Field, Manor Park, Highgate, N.

Catalogues and Lists.—The Perfecta Seamless Steel Tube Co., Ltd., of Plume Street, Birmingham, have issued a new price list (No. 3) in which they detail their steel conduit system for electric wiring. It is manufactured in two classes, viz., light conduits, which are united to themselves and to their fittings by being lightly driven home in very smooth-bored interiors, and heavy gauge conduits, which are connected with each other and the fittings by accurately screwed joints. Brazed and unbrazed, seamless, welded and brass-cased conduits and a variety of couplings, bends, tee-pieces, junction boxes, and so on, are illustrated and priced in some 50 odd pages.

The Metallic Seamless Tube Co., Ltd., of Wiggin Street, Birmingham, have just sent us a copy of their new catalogue of metallic steel conduit and accessories for electric wiring. A table stating the wiring capacities of different diameters of conduits, light and heavy gauge, is followed by some details of the Bayliss patent grip system for obtaining metallic connections. The list is well illustrated with blocks showing various fittings and accessories, split tees, crosses and bends, branching and jointing boxes, ceiling roses, &c.

Messrs. Thomas Smith & Sons, of Old Foundry, Rodley, near Leeds, have issued a neatly illustrated pamphlet of their steam and electric cranes. The works are fitted up with electric lighting and driving plant, and electrically-driven cranes of the latest types and other machinery is to be seen there. The illustrations show long radius fixed, adjustable jib and yard locomotive cranes, three-

motor and one-motor overhead travellers, electric Goliaths, hoists and derrick cranes.

Messrs. Bayliss, Jones & Bayliss, Ltd., of Victoria Works, Wolverhampton, have issued a pamphlet describing the "Helicoid" lock-nut, they having acquired the patents, machinery and goodwill appertaining thereto.

Messrs. Markt Bros. & Co, of 38 and 39, Beach Street, Barbican, E.C., have issued a new catalogue of electrical accessories for the 1904 season. A large variety of lampholders, nipples, tumbler switches, main switches, wall plugs, fuse and switchboards, measuring instruments, arc lamps, wires, fans, motors and many other things are shown in Sec. 1 (86 pages); Sec. 2 is devoted to electric bell and telephone apparatus and novelties.

Messrs. B. Weaver & Co., of 22, Rosoman Street, Clerkenwell, E.C., have brought out some wall sheets of dimensioned drawings of many sizes of "Ebonestos" insulating switch handles, bushes and nipples, which they hold in stock, also lists giving prices per gross.

Messrs. W. F. Stanley & Co., Ltd., of Great Turnstile, W.C., have issued a new catalogue (G), in which they give illustrations, prices, and so on respecting their engineering, surveying, drawing and other instruments.

A catalogue of Röntgen ray electro-medical and Finsen light apparatus has been received from Mr. Max. Kohl, of Chemnitz. In some 150 pp. such apparatus is fully described, illustrated and priced. The letterpress is in German.

The British Thomson-Houston Co., Ltd., has issued the following new lists:—No. 155, relating to induction motors; No. 156, dealing with enclosed arc lamps, and containing numerous illustrations of the lamps themselves and views of places lighted with them; No. 157, describing patent oil switches; and No. 158, detailing overhead trolleys.

The Cleveland Crane and Car Co., of Wickliffe, Ohio, has placed before us a number of its bulletins:—F, showing the Armington electric hoists; G, describing the Cleveland hand and electric jib cranes; H, detailing hand-power cranes; and J, devoted to electric travelling cranes.

Messrs. R. E. & C. Marshall, electrical contractors, of Clarence Street, Cheltenham, have published a very attractive pamphlet of 24 pp., in which they give certain "Notes on Some Uses of Electricity." The object of the notes is to persuade the general public to become electric light users. The good points of electric illumination are well driven home, and a very lengthy list of Corporation and private installation contracts carried out by the company occupies the last few pages.

"Kleenall."—This is the name of a material which has been produced and patented by Mr. W. Drybrough, of the firm of Boardman Bros., Manchester, for cleaning engines or machinery, and is free from size, dust, grit or other deleterious material. It is a cloth woven of the softest possible cotton yarn, absolutely pure as it comes from the spinner. Many things have been employed up to the present time by engineers for cleaning purposes, such as waste, bleached or otherwise, washed rags, washed meat cloths bleached or unbleached, but as soon as the fibre, whether in waste or in other material, has been bleached, its absorbent properties are reduced to a minimum; "Kleenall" is claimed to contain cotton fibre in its perfect state, and the absorbent properties are fully retained. One of the great disadvantages of waste is the fact that it falls to pieces. "Kleenall" is supplied in cloth form in rolls, and it is only necessary to cut off the quantity required from the roll. Every inch or ounce of the material can be used for cleaning purposes, thus effecting considerable economies. It is further claimed that its absorbent properties being all retained, it will take a much longer time to become impregnated with oil or grease than any other material at present in use. It is supplied in 25, 50, and 100-yard rolls, and consequently will take up very much less space in store, than its equivalent in, say, sponge cloths, waste or rags, and it is made up in widths of 14 in., 22 in. and 44 in.

Trade Announcements.—Messrs. W. H. Allen, Son and Co., Ltd., have appointed Messrs. Inniss & Riddle, City Chambers, 82, New Street, Birmingham, to represent them in Birmingham and the neighbourhood.

Messrs. L. M. Ericsson & Co., Ltd., have removed from Temple Chambers to Byron House, 82 to 85, Fleet Street, London, E.C.

The firms of W. D. Palmer & Co, mechanical, electrical, and water-power engineers, at 50, Wellington Street, Glasgow, and Neil Taylor & Co., electrical engineers and contractors, 74, York Street, Glasgow, and 89, Bank Street, Coatbridge, have been amalgamated, and will be carried on under the name of Palmer & Taylor.

Books Received.—"La Telegraphie sans Fil, L'œuvre de Marconi," by E. Guarini. Translated from the *Scientific American*. Brussels: Ramlot Frères & Sœurs. Fr. 2.50.

"A Handbook for the Electrical Laboratory and Testing Room," by J. A. Fleming. Vol. II. London: The *Electrician* Printing and Publishing Co., Ltd. Price 14s.

"Gas and Oil Engine Management," by M. P. Ball. London: Crosby Lockwood & Son. 1903.

"Science Abstracts," Sections A and B. Vol. VI., Part 10. London: E. & F. N. Spon, Ltd. 1s. 6d. each.

"Electric Lighting and Power Distribution," Vol. II., by W. P. Maycock. London: Whittaker & Co., 1903. 7s. 6d.

New Intercommunication Telephone Set.—A new automatic intercommunication telephone set has recently been brought out by the Consolidated Electrical Co., Ltd., of Canonbury, which possesses some interesting features. The set has been designed to compete with instruments of foreign manufacture. The quality of the instrument, with regard to both material and workmanship, is of the highest class, while the design is neat. The patent consists principally in the fact that it is possible, with this apparatus, to manipulate the keys whether the converser be on the cradle or not. This, it is stated, is not possible with any other apparatus of similar type. This detail alone makes the instrument of great value, as, in using an instrument constantly, it is annoying when one has finished

speaking to one person to have to put the "converser" back on the cradle before ringing another person. The instruments are made in three different varieties—table form, the ordinary wall form, and a new pattern of wall form having a desk and battery box combined. There are six standard sizes—namely, 5, 10, 15, 20, 25, and 30 lines. All the instruments are fitted with the company's standard converser, of the same pattern as is used for their most expensive instruments.

Judging from a sample set which we have before us, the finish and workmanship of the apparatus are of a very high quality. The appearance of the ordinary wall form is shown in the above illustration.

Bankruptcy Proceedings.—A motion arising out of the failure of William P. Durtnall, electrical engineer, 85, Finsbury Pavement, E.C., and Caversham Road, Reading, came before Mr. Justice Wright sitting as Bankruptcy Judge, on Monday, in the King's Bench Division of the High Courts of Justice. The debtor failed last November with liabilities £1,464 3s. 7d., ranking against assets valued by him at £1,119 19s. 10d. Mr. Wallace, K.C. (with him Mr. Elliott) appeared in support of the motion which was brought by Mr. Percy Mason, and asked for a declaration that a sum of £154 4s. 9d., which the applicant was ordered by the Court on March 16th, 1903, to pay to Mr. E. H. Hawkins, the trustee of Durtnall's estate in bankruptcy, was money properly expended in the interests of the creditors, and in and about preserving the assets of the bankrupt under a deed of assignment dated May 22nd, 1902; or in the alternative that the same was a just allowance to which the applicant was entitled out of £241 17s. 11d. which he recovered in an action against Wyman & Sons, Ltd., in connection with a contract for the installation of electric light and power at the Reading works of that firm. Mr. Clayton was briefed for Mr. E. H. Hawkins, the trustee, to oppose the motion, and Mr. J. B. Matthews intervened on behalf of Mr. Ernest Roberts, who asked the Court to say that a charge of £142 10s. and interest given to him by the debtor upon the money coming to the estate from the Wyman contract formed a first charge upon the assets in the hands of the trustee. Mr. Wallace explained that Mr. Mason was appointed the trustee under a deed of arrangement in May, 1902, executed by the debtor. Whilst he was acting as that trustee with the sanction of a Committee of Inspection, he spent certain moneys in the completion of Wyman's contract, the Committee being of opinion that it would be to the benefit of the creditors to expend the money in that way. Some months afterwards a petition was presented by one of the creditors who stood out for the deed of arrangement. Mr. Durtnall was made bankrupt in due course, and Mr. E. H. Hawkins was appointed as trustee in the bankruptcy. Then arose the petition of Mr. Mason, who had expended £160 in connection with the Wyman contract in order to complete it, and an application was made by Mr. Hawkins to the Court that Mr. Mason should pay over the moneys he had expended as being moneys of the estate. On March 16th, 1903, the Court made an order for the moneys in question to be paid over to the bankruptcy trustee under certain conditions. The Court at the same time gave leave for an action commenced by Mr. Mason against Wyman & Sons, Ltd., to be continued by Mr. Hawkins, on the indemnity of Mr. Mason, who undertook not to compromise the action without the leave of the Court. The action came before the Court on July 28th, 1903, when Wyman offered to settle by paying a sum of £400, which was to include costs. By the leave of the Court that offer was accepted. The £400 was reduced to £241 by the costs of the action, and from that balance Mr. Mason asked to be paid the £154 he had expended on the Wyman contract when acting as trustee under the deed of arrangement. He also asked to be paid £25 as an allowance for acting as trustee under the deed. Those payments would

reduce the balance received from Messrs. Wyman to about £60. Mr. Clayton said Mr. Hawkins was willing to give up to Mr. Mason every benefit that had been received from the Wyman contract provided that he would be allowed to retain for the benefit of the creditors that part of the estate which was entirely independent of the said contract. Mr. J. B. Matthews said his client was a creditor of Mr. Durtnall long before Mr. Mason came on the scene, He obtained judgment in February, 1902, for £178 14s. 3d., but by April 11th, 1902, the debt had been reduced to £155. On that date Mr. Durtnall executed to Mr. Roberts a charge upon the moneys coming to him from the Wyman contract for that sum and 5 per cent. interest, and a notice thereof was sent to Messrs. Wyman in order to perfect the charge. Its validity was not called into question. Subsequently two small sums were paid to Mr. Roberts, thus reducing the amount to £142 10s., in respect of which, together with interest, the Court was asked to say constituted a first charge on the Wyman fund in the hands of the trustee. His Lordship held that Mr. Roberts was entitled first to his debt of £154, and to his taxed costs in this motion. The next charge would be Mr. Mason's costs in the action against Messrs. Wyman, and the amount he had properly expended in connection with the contract. The trustee was entitled to his costs out of the estate. Order entered accordingly.

Edwin Ward, trading as E. Ward & Co., electrician, 38, Osborne Road, 108, Bevois Valley, and 47, Lodge Road, Southampton. This debtor was examined at Southampton Bankruptcy Court on October 28th, on accounts showing liabilities amounting to £397, of which £13 14s. is due to preferential creditors. The assets are valued at £36, and there is a deficiency of £347. Debtor attributes his failure to want of capital, losses on contracts, bad trade, competition and bad debts. The examination was closed.

Dissolutions and Liquidations.—Tuesday's *London Gazette* contains an announcement that Messrs. Estler Bros., of Laurence Pountney Lane, E.C., as creditors have lodged a petition for the winding-up of Messrs. Ferranti, Ltd., of Hollinwood. The petition will be heard in London on November 17th.

Messrs. F. W. Walker and W. R. Gray (Gray & Harris, electrical engineers, Putney Bridge Road, and Westminster) have dissolved partnership.

ELECTRIC LIGHT AND POWER NOTES.

Bedford.—The T.C., with the object of securing a day load, has reduced the price of energy for motors from 2d. to 1½d. per unit, as from April 1st next.

Belgium.—A company is erecting a generating station near Wasmer, Mons, for supplying energy for light and power in several towns in the district.

Bilbao.—The electric lighting works has been blown up with dynamite by strikers.

Bridgend.—The U.D.C. has agreed to instal the electric light in the Workhouse, and has fixed the price at 4½d. per unit.

Buenos Ayres.—The *Elektrotechnischer Anzeiger* states that the Allgemeine Elektricitäts Gesellschaft and the Deutsche Bank together bought the Primitiva Gas and Electric Light Co.'s generating station at a cost of 15,000,000 francs.

Cheshunt.—The U.D.C. has sealed an agreement for the transfer of the electric lighting order to the North Metropolitan Electric Power Distribution Co. on payment of £210, the cost of obtaining the order. The average price of energy to the Council will be 2½d. per unit, and to private consumers 4½d.

Chorley.—The T.C. on October 29th decided to lease its E.L. order, which was obtained in 1898.

Cirencester.—The U.D.C. has resolved not to assent to the application by the Southern District Electricity Corporation for a prov. order for the supply of electricity in the town.

Dorchester.—The T.C. has resolved to lease its order for the electric lighting of the town to a company.

Dumfries.—On 29th ult. the T.C. called together the ratepayers of the burgh to consider proposals with regard to the introduction of the electric light. The town clerk submitted to the meeting an abstract of the tenders of Messrs. Frank Suter & Co. and the National Electric Wiring Co. The former proposed that the T.C. should borrow £16,300 to cover the capital cost, the company to pay the interest and sinking fund charges on that sum, to assume the whole risk of loss, and to share the profits with the Council, and the Council to have the right to take over the undertaking at any time without payment, on giving 12 months' notice. The National Electric Wiring Co. proposed that the Council should find the capital, estimated at £17,500, the company to pay the interest and sinking fund charges during the first 10 years, all profits in excess of 3 per cent. to be divided between the Council and the company, and the Council to have the option of taking over the concern at 10 or 15 years. By a large majority the meeting decided not to go any further with the scheme, but that if the Council could sell the prov. order to any company it should do so on the best terms.

Dundee.—The Caledonian Railway Co. have completed arrangements for installing the electric light at Dundee West Station goods department and sidings. The arrangement, like that in force at Tay Bridge, provides for the supply of energy from the Corporation works, the installation being carried out by the company's engineers.

France.—A company is about to be formed to carry on an undertaking for the electric lighting of Saint-Géry (Lot), and neighbourhood.

Garlands.—Cumberland C.C. has decided to have the electric light installed in Garlands Asylum at an estimated cost of £8,000.

Germany.—The erection of a generating station for lighting the town of Hoym (Anhalt) has just been decided upon.

Gloucester.—We are informed that, owing to the unsatisfactory nature of the replies received from manufacturers, the Corporation has been compelled to abandon the proposed electrical exhibition.

The L.G.B. has authorised the T.C. to raise a loan of £24,673 for electric lighting purposes.

Halifax.—The T.C. has instructed the electrical engineer to arrange for the erection of a sub-station at an estimated cost of £400.

Hampton Wick.—On Monday the D.C. decided to obtain expert opinion upon an application by the Twickenham and Teddington Electric Supply Co. for consent to a prov. order they are seeking. The company offered to give the Council the right to purchase in 7, 14 or 21 years, to supply energy for public lighting at 2½d. per unit, and to private consumers at 7d. per unit for the first hour per day at the maximum demand or its equivalent, and 3d per unit afterwards.

Heavitree.—The Exeter T.C. has resolved to communicate with the D.C., expressing its willingness to entertain a proposal for introducing the electric light into the district.

India.—Messrs. Burn & Co., of Calcutta, have recently completed an installation for supplying energy for light and power purposes at Attock.

Llanelly.—The B. of T. has threatened to revoke the prov. order for the electric lighting of the town, in consequence of which the U.D.C. has decided to take action to compel the specific performance of the contract with the British Insulated Wire Co.

London.—Plumstead.—On the 29th ult. the new generating station, erected on Plumstead Marshes by the Woolwich B.C., was opened by the Mayor and Corporation. The plant installed includes five Willans engines coupled to Westinghouse generators. The expenditure on the station, including cables and 80 arc lamps, is £46,000, and on the buildings and dust destructor £44,000. There has also been expended £4,280 on a brick-making plant. The number of consumers at present connected is 54, using 3,710 8-c.p. lamps, the cost of energy being 4d. per unit, without rent for meters. At the conclusion of the ceremony the Mayor christened the five engines as follows:—"Mayoress," "Flossie," "Wilhelmina," "Gertrude," and "Muriel." Who can doubt the brilliant future that lies before the department after this?

The Gaiety Theatre.—The electric lighting installation at the new building, recently opened, has been carried out with a view to minimise the risk of failure of supply as far as possible. The energy is supplied from 12 circuits, which are connected to two distinct companies' mains. The stage is fitted with 1,500 incandescent and 24 arc lamps, and in the house there are 1,800 incandescent lights.

Marylebone.—The B.C. on the 29th ult. considered the question of promoting in the next session of Parliament a Bill for amending the electric lighting order. Mr. Ernest R. Debenham, chairman of the Electric Supply Committee, moved, and Mr. Paxton seconded, a resolution stating that it was expedient to promote a Bill next session empowering the Council to borrow the necessary money to purchase the Marylebone works of the Metropolitan Electric Supply Co. for the erection of electricity works, to authorise an increase in the maximum charge for the supply of electricity, and to alter the method of charging. Power will also be obtained to erect a generating station in the district and to construct a short line of railway connecting the generating station with the Great Central Railway. The motion was carried by 43 votes to 8. By a second resolution, which was also carried, the town clerk was directed to instruct Parliamentary agents to take all necessary steps in connection with the proposed Bill. The expense of promoting it is to be charged upon the general rate of the borough.

Shoreditch.—The B.C. intends shortly to apply to the L.C.C. for its approval to an alteration in the pressure of supply to consumers in its area. At the present time energy is supplied at a pressure of 150 volts D.C., for both lighting and power, on the two-wire system. It is desired to alter this into a D.C. supply at

240 volts for lighting, and 480 volts for power on the three-wire system.

Wandsworth.—The B.C. is asking the B. of T. to require the County of London and Brush Provincial Electric Lighting Co. to keep separate accounts for Wandsworth and Clerkenwell. At present 4½d. is the average price of energy supplied to the two boroughs combined. The contention of Wandsworth is that while the charge made in Clerkenwell is below this average, the southern borough is paying approximately 5·77d. per unit.

Hackney.—On the recommendation of the E.L. Committee, the B.C. has resolved that the price of energy for lighting railway companies' premises be at the rate of 8d. per unit for the first 100 units per KW. maximum demand per quarter, and 2d. per unit afterwards.

St. Pancras.—The St. Pancras Borough Council has received a letter from the L.C.C. with reference to the application for a loan of £30,000 for electric lighting purposes, stating that the C.C. is prepared to advance £23,960, repayable with interest at the rate of £3 15s. per cent. per annum by equal half-yearly instalments of principal and interest combined within 42 years, the B.C. to pay the cost of the loan. The town clerk informed the Council that the Prudential Assurance Co. was prepared to advance the money at £3 12s. 6d., and, as the period was 42 years, the saving would run into something considerable. The Council deferred decision in the matter.

Leatherhead.—The B. of T. has just given its decision in a case of very considerable importance to all electric lighting companies. The Leatherhead and District Electricity Co. has a considerable system of mains laid down in Leatherhead and also in Mickleham, and recently gave notice to the Epsom R.D.C. of its intention to proceed forthwith to lay mains in the Parish of Ashstead, which comes within the Council's area, submitting at the same time plans showing that the mains were to be laid at a depth of 18 in. under pathways and 2 ft. under the roadways. The mains are Glover's three-core paper-insulated lead-covered, laid solid in Howard asphalt conduits. The Council refused their sanction to the laying of the mains unless the company put them at a depth of 3 ft. throughout. This the company objected to, and on the advice of their consulting engineers, Messrs. Handcock & Dykes, appealed to the Board. The appeal was heard on the 22nd ult., the Council being represented by counsel; Messrs. Handcock & Dykes, and Mr. L. Atkinson, the London Manager of Messrs. W. T. Glover and Co., the contractors for the work, gave evidence on behalf of the company.

The Council urged first that in their opinion all electric lighting mains, as well as gas and water mains, should be laid at a continuous depth of 3 ft., on account of the danger of damage, and secondly because, if the mains were laid at 18 in. under the pathway, and the roads were subsequently widened, the Council might be at the expense of lowering these mains if the alterations should bring them too close to the surface.

The B. of T. has just announced its decision, allowing the appeal of the company on all points.

Maesteg.—The U.D.C. has just obtained a prov. order for electric power and light within its area. At a meeting of the Council last Friday the subject came up for consideration as to which course the Council will adopt, either to erect and construct the whole of the generating plant, cables, &c., at its own cost, or to enter into negotiations with a company, to which the Council would transfer its order, with a view to the company erecting and working the whole thing, and supplying all customers with light and power at a price to be arranged between Council and company, all public lights to be also on the same terms. It is stated that the probability of several large collieries taking a supply of energy for power will conduce to the running of the generating plant at a low cost.

Manchester.—The T.C. intends promoting a Bill in the next session of Parliament for power to supply electricity in bulk and otherwise beyond the city.

Mansfield.—An electrical exhibition was held last week at the Town Hall in connection with the Corporation Electricity Department; all the necessary arrangements were made under the supervision of Mr. W. J. Chadburn, chairman of the Committee, and Mr. Hewlett, the electrical engineer. The object of the exhibition was to acquaint the local public with some of the possibilities of electricity, including lighting, heating and motive-power.

Motherwell.—The Clyde Valley Electric Power Co.'s works, which are in course of erection, were destroyed on Thursday night last week. Without any warning, the large iron structures are stated to have collapsed, and hundreds of tons of material lay on the ground. The cause of the accident has not yet been ascertained, but it is supposed to be due to the wind. Fortunately, none of the workmen were injured.

Newcastle Emlyn.—A scheme has been drawn up for the lighting of the district by electricity. A company is to be formed, and it is proposed that each shareholder of £50 and upwards be asked to subscribe 6d. for every £1 share to meet the initial expenses. It is stated that Lord Cawdor and another gentleman have intimated that they will each take a hundred £1 shares in the concern.

Newcastle (N.S.W.).—In view of the Council's decision to extend its electric lighting plant, at a cost of £300, inquiries have been made with regard to the introduction of steam turbines.

Newhaven.—The U.D.C. has consented to the application of the Southern District Electricity Corporation for a prov. order to supply electricity to the town.

Norwich.—The Corporation has instructed Mr. F. M. Long, its electrical engineer, to obtain information as to the lighting of Catton by electricity. It is stated that the majority of the principal residents of Catton are in favour of the scheme.

Pollokshaws.—The T.C. will not consent to the application of the Clyde Valley Electric Power Co. for a prov. order to supply electricity within the burgh, as it intends to apply for a similar order itself.

Portpatrick.—The Wigtownshire C.C. has consented to the Portpatrick Electric Supply Co., Ltd., applying to the B. of T. for a prov. order for lighting the parish.

Portsmouth.—A loan of £24,000 is to be applied for by the T.C. to cover the cost of laying new E.L. mains during the next three years.

On the recommendation of the E.L. Committee the T.C. has agreed to the sinking of a well at the E.L. works at an estimated cost of £762, but with an agreement that in the event of water not being found, the charge be £500. It is estimated that a saving of about £500 per annum for water will be obtained if the operations are successful.

Ramsgate.—The T.C. has consented to the promotion by the Ramsgate and District Electric Supply Co. of an order for the electric lighting of the borough, subject to special terms as to the purchase of the undertaking by the Corporation.

Redditch.—On the 3rd inst. the D.C. decided to obtain permission to raise a loan of £8,500. Of this sum £5,581 is required to cover expenditure already incurred, the remainder being required for extensions.

Risca.—The U.D.C. has decided to oppose any private companies seeking powers to supply electricity to the town.

St. Austell.—The U.D.C. has resolved to call the attention of the B. of T. to the notice the Council has received from the United Kingdom Electricity Syndicate, stating that the supply of energy will be suspended, and to ask the B. of T. if the syndicate were in order in the action they were taking.

Salford.—Local comment is made on the financial position the Salford tramways and electricity undertakings, which, from a ratepayer's point of view, are not altogether satisfactory. The total deficiency on the electric lighting revenue account, since its commencement eight years ago, amounted at the end of the last municipal year to £35,446. The deficit on last year's working (£2,390) was carried forward, but the remaining £33,056 has year by year been paid out of the rates. The decrease in the deficiency from £13,214 in 1901-2 to £2,390 for the year ending March 31st last is accounted for by the increased demand for electricity for tramway traction, and the high rate of charge made for it, rather than to any abnormal growth in the demand for private consumption. For consumers who guarantee a consumption of 50,000 units per annum for power purposes a "special price" of 1½d. per unit net is charged; but the Tramways Committee, which is the largest consumer, is charged 2d. per unit for energy, less 2½ per cent. discount. Last year the Tramways Committee was supplied with 3,370,434 units, for which it was charged £27,384 15s. 8d. The same amount of energy would have been supplied to any outside manufacturer under the "special price" for £17,554—a difference of £9,830 against the Tramways Committee. Capital charges on excess of plant provided for tramway purposes, and not yet brought into beneficial use, are urged in justification of the extra charge for energy for tramway purposes. The demand for energy on this account is increasing. The more energy used, the more is paid in reduction, not only of capital charges on tramway plant, but also of those on electric lighting plant. In the early part of the financial year, just closed, the whole of the tramway system was not in operation, and only from 120,000 to 200,000 units per month were consumed. By the close of the year the consumption had increased to 370,000 units per month. The probability is that, with the extensions and developments of the tramway system which have recently taken place, the excess charge for energy will increase next year from £10,000 to £15,000. The equitable and most satisfactory way of working the tramways, it is considered, would be to set aside a fixed sum for interest and sinking fund charges on the excess capital expenditure, and supply the Tramways Committee with energy at the same rate as the low-priced customer is charged—namely, 1½d. per unit net. It is doubtful whether the reserve set apart to meet depreciation and renewals is adequate. The Tramways Committee have promised to increase their contribution in aid of the rates next year to £12,000; but this, it is pointed out, can only be done at the risk of starving renewals and making inadequate provision for depreciation. The power charges, together with the demands on revenue in aid of rates, are said to be hampering the undertaking.

The Council has resolved to apply to the L.G.B. for a loan of £10,000 for the purchase of motors for hiring-out purposes.

Spain.—A concession has been granted to put down plant to utilise the water power of the River Guadalquivir at Tilin in the generation of electrical energy for distribution to Mancha Real and Jimena for lighting and power purposes.

A central station has just been completed at Pradillo for the supply of energy for lighting purposes in a number of small towns in the district. Water power is utilised, the plant comprising a 55-H.P. turbine and a 36-KW. two-phase generator.

Stoke-on-Trent.—The T.C. on Thursday decided to approach the Fenton U.D.C. with a view to the Corporation supplying electricity to Fenton in bulk.

Sutton-in-Ashfield.—The U.D.C. has decided to apply to the B. of T. for a prov. order for electric lighting within its district.

Teignmouth.—The D.C. is to apply for a prov. order to amend the Electric Lighting Order of 1899, to enable the Council to transfer the undertaking to Messrs. Crompton & Co., Ltd., upon such terms and conditions as, subject to the approval of the B. of T., might be arranged between the Council and the company.

Treeton.—It has been decided to approach the Rotherham Colliery Co., with a view to their supplying energy for the lighting of the district.

West Bromwich.—The public electric lighting scheme for the borough was inaugurated on Tuesday last week, when the Mayor switched on the lamps along the High Street.

West Ham.—The Council has decided to purchase a motor-car at a cost of £230 for Mr. J. K. Bock, the electrical engineer. It was pointed out that Mr. Bock was now supervising work which would total £200,000, that the necessity for a means of quickly getting about the district was urgent, and that a saving would be effected by largely doing away with the cost of cabs and conveyances for the electrical staff. Reports were received to the effect that a commencement would shortly be made in supplying electricity from the new works at Canning Town. The removal and re-erection of machinery from Abbey Mills would then be proceeded with, and is expected to occupy six months. Mains are now laid in about 40 miles of streets.

Wood Green.—The U.D.C. has resolved to apply to the L.G.B. for permission to borrow £43,000 for lighting its area by electricity.

Wolverhampton.—The T.C. has adopted the recommendation of the E.L. Committee for an expenditure of £850 for the construction of steel and timber coal bunkers outside the boiler house of the electric lighting works, the laying down of a portable railway from the bunkers to the canal wharf, a distance of 110 yds., and the provision of a three-ton electric locomotive crane to be run thereon. The object of this is to improve the present method of unloading the coal from the barges, and its speedier transmission to the bunkers or stock heap as required.

The T.C. has also adopted a scheme whereby houses of a rental of from £40 to £65 a year will be wired for the electric light on the easy-payment system. The capital outlay per house will be £26, and the revenue £9 3s. 4d. a year. If this proves successful, the scheme will be extended to houses at lower rentals.

The mains are to be extended for power purposes along Dudley Road, Sedgley Street and Upper Villiers Street at a cost of £1,080.

Worthing.—The T.C. has fixed the price of energy to private consumers at 6d. per unit with 5 per cent. discount if 1,000 to 5,000 units are used per year, and 10 per cent. for over 5,000 units.

Wormit.—The Tayside Electric Light and Gas Co. has intimated that it intends to raise the price of energy 25 per cent., and impose a minimum of 8s. per quarter, making the price 7½d. per unit.

Yardley.—The R.D.C. has resolved to apply to the B. of T. for a prov. order enabling it to supply electricity within the district.

ELECTRIC TRACTION NOTES.

Altrincham.—A majority of the ratepayers has, by a vote recently taken, declared in favour of the District Council applying for a prov. order for the construction of tramways in the district.

Canary Islands.—Application has been made for a concession for a projected electric tramway from the Puerto de la Luz to Sardinia, Canary Islands.

Germany.—The municipal authorities of Monheim-am-Rhine have decided to start a service of rail-less electric cars between that town and the railway station at Langenfeld.

Greenock.—The decision has just been given by the arbitrator appointed by the T.C. and the Tramway Co. to settle a number of points of dispute in connection with the tramway lease. The arbitrator was asked to fix the price which the company should pay the Corporation for electricity over 500,000 units. The decision is that for each unit taken beyond this amount the company shall pay $\frac{1}{10}$th of a penny, a trifle less than ¾d. per unit. The T.C. Electricity Department found that it cost them fully 1d. per unit to produce electricity.

Kirkcaldy.—The present extension of the electric tramways is nearing completion, and will be in operation by the beginning of December. Two more miles of line will thus be added to the service. The burgh authority is seeking Parliamentary powers to double certain parts of the original route, and, instead of laying a single line, to have a double line to Dysart, which will be the next extension of the service.

Lincoln.—The B. of T. has appointed Col. Colin Scott Moncrieff, R.E., as arbitrator to fix the price to be paid for the tramways undertaking. The Corporation resolved to purchase the undertaking, and to substitute an electric tram service; but the offer was rejected by the shareholders of the tramway company.

London.—At Tuesday's meeting of the London County Council the Highways Committee reported as follows:—The Council on October 14th, 1902, decided to enter into an arrangement with the London Electric Supply Corporation for the temporary use by the Council of a part of the company's premises at Deptford, and for the supply of steam from the company's boilers for the working of generating plant to be placed there by the Council in connection with the electrical working of the New Cross and Greenwich sections of its tramways. The reconstruction of these tramways is now almost completed, and the arrangements with regard to the erection of the necessary plant at the company's generating station are nearly completed, and it is hoped that it may be practicable to commence the electrical working of the tramways early next year. The agreement entered into with the company with regard to the matter provides for the payment by the Council of a rate to be agreed, but not exceeding 1½d. per unit of electricity generated. The Council's plant at Deptford will be in the same engine room as that of the company, and the question has arisen as to the advisability of having two separate staffs in the same building under different control. It has been suggested that the company should take over the running of the mechanical plant and be responsible for all repairs, maintenance and stores for an inclusive charge of 1·65d. per unit, including the supply of steam. We think that it would be advisable, however, for the Council to employ a charge engineer to give instructions as to the running of the plant, to supervise the working of the switch-gear, and also to make necessary repairs to the electrical plant. Having regard to the circumstances we are of opinion that this arrangement would be the most economical and convenient one to be made, and it is probable that the extra cost involved in the increased charge of 0·15d. per unit would not exceed the expenditure incidental to the establishment by the Council of its own staff of workmen. We may add that the rate of pay for charge engineers employed at temporary electricity generating stations of the London County Council Tramways was fixed by the Council on March 17th, 1903, at from £3 10s. to £4 10s. a week, and a charge engineer proposed to be employed at Deptford will be paid according to this rate. We recommend:—

That the resolution of October 14th, 1902, with regard to the arrangement to be entered into with the London Electric Supply Corporation, in connection with the supply of steam power by the company for the working of the Council's tramways, be varied so as to provide for the payment by the Council to the company in respect of the supply of steam, the running of the mechanical plant, the carrying out of the necessary repairs, the cost of maintenance and the supply of stores, &c., at a rate not exceeding 1·65d. per unit of electricity generated.

Lambeth.—It was resolved by the B.C. at their last meeting to ask the L.C.C. not to commence the work connected with the electrification of the Brixton to Streatham tramway until after the Christmas holidays, and then to proceed, in the business parts, with night and day shifts.

Manchester.—Our notes of last week regarding the last half-year's working, may be supplemented by the following figures:—The total operating expenses per car-mile during the half-year were 6·67d., as compared with 6·95d. in the previous year. Electrical energy cost 1·82d., as compared with 1·94d.; traffic expenses—wages, cleaning, &c.—were 3·43d., as compared with 3·53d.; management expenses were reduced from ·75d. to ·68d.; and repairs and maintenance rose from ·73d. to ·74d. Mr. M'Elroy adds that the whole of the official staff have endeavoured by exercising economy in every possible direction to reduce the operating expenses, having at the same time due regard to the efficiency of the system. The accountant prepares for the general manager a weekly profit and loss account in order that he may see the financial results of the undertaking week by week. The operating costs are carefully watched, and increased expenditure under any head is at once detected and the head of the department concerned is asked for an explanation. This system tends to ensure careful and economical management.

The recent reduction of long-distance fares on the Manchester tramways has had the effect of stimulating traffic. The new circular route in the Ancoats district, connecting Philips Park with Piccadilly by way of Oldham Road, Butler Street and Bradford Road with Piccadilly was opened last week.

Newcastle-on-Tyne.—At a meeting of the T.C. on the 28th ult., Mr. Cail presented on behalf of the Tramways Committee, a report recommending the construction of a route to connect the routes of Chillingham Road and Heaton Road. The estimated cost was £6,800. There was some warm speech-making, and in the end the matter was referred back to the Committee with instructions to prepare plans for submission to the T.C.

The Tramways Committee is to obtain about 2,000 tons of new rails to be used for renewals, and if possible to obtain them from English firms.

Paisley.—The work of electrification of the trams was begun on Monday, but the following day the Council decided to present a petition for interim interdict to the Sheriff against Mr. Murphy using Swedish or Norwegian setts for the paving of the streets instead of Scotch granite. The matter has been one of dispute between the T.C. and Mr. Murphy, and it was agreed to refer all points of difference to a Board of Trade arbitrator. Pending this decision Mr. Murphy proceeded with the work, hence the application for interdict.

(*Continued on page 747.*)

BRUSSELS ELECTRIC TRAMWAYS.

Electric traction has been in operation in part of Brussels since the year 1894, with both overhead trolley and underground conduit sections added at various dates. These tramways were fed with direct current from a generating station, which was extended as required to cope with the demand; but when, in 1899, the Tramways Co. obtained a concession for the working of the whole of its lines by electric traction for 45 years, in addition to certain external routes, it became necessary to reorganise the whole of the arrangements for the supply of power to the lines. It was decided to establish an entirely new power station on the bank of the Charleroi Canal, from which electricity generated on the three-phase system should be transmitted at high pressure to sub-stations equipped with transformers and rotary converters.

The works are laid out parallel to the canal, with ample space for extensions, and are founded on armoured concrete 1·5 m. thick, extending over the whole of the site of the buildings. The latter are of the steel frame type, carried on walls about 4 m. high from the foundation; the structure of the walls and roofs is indicated in the sectional view given herewith. There are two chimneys, one at each end of the boiler house, 60 m. high and 3 m. in diameter.

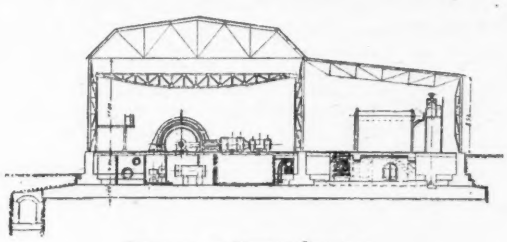
A masonry channel brings water from the canal alongside the engine room for condensing, the hot water being afterwards returned to the canal at a point 100 m. away.

The boiler house contains 10 boilers, made by Messrs. Babcock & Wilcox, each having 176 tubes, with a total heating surface of 350 m². ; these are arranged in batteries of two each, and are hand-fired with the exception of two, which are provided with chain grate stokers. A Green economiser is fitted to each battery, consisting of 280 tubes, and Babcock-Wilcox superheaters are also provided. The working pressure is 150 lbs. per sq. in. Eight additional boilers from the old generating station are to be transferred to the new works. The feed pumps are driven direct by the main engines; two separate steam-driven pumps and one motor-driven pump are also installed as reserve plant. The boilers can be fed either from the hot well or from the town water mains.

Coal is brought to the works by canal or by wagons, and is handled entirely by machinery, as far as the stoking floor. For this purpose a grab, holding about half a ton, is suspended over the canal by means of an iron framework, shown in one of our views, and lifts the coal from the barges into a hopper, whence it passes by way of a coal-crusher on to an endless belt, running over the whole length of the bunkers. The coal is automatically weighed before passing into store. From the bunkers the coal is fed as required into an oscillating trough, which delivers it to an endless belt conveyor running to the boiler house. Here the coal is received by a bucket chain conveyor, which carries it into hoppers delivering on the stoking floor in front of the respective boilers; the same conveyor is used to remove the ashes from beneath the boilers to separate hoppers.

The steam range in the boiler house forms a complete ring, one leg of which is used solely to connect the ends of the main range, to which the branches from the boilers and engines are connected. The piping is of drawn steel.

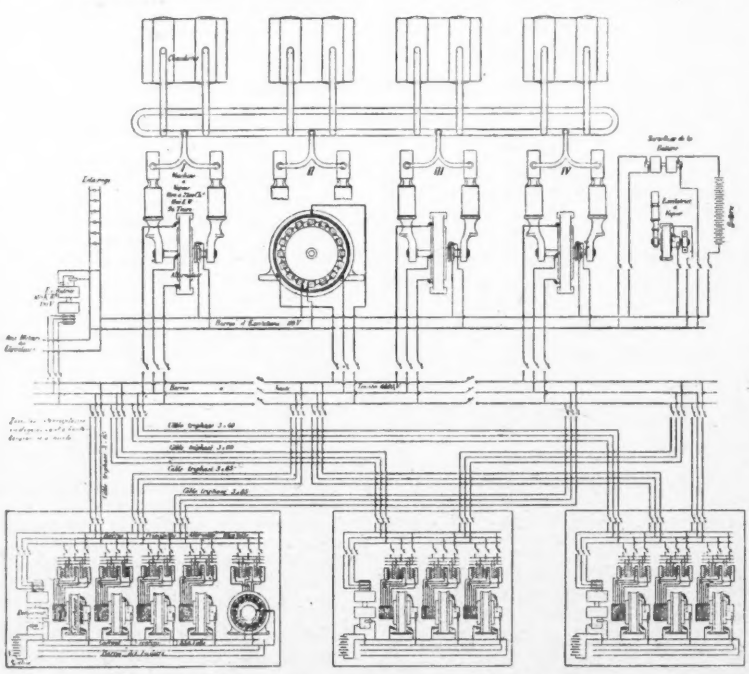
The engine room at present contains four generating sets of 1,500 kw. each, and space is available for three similar sets. The engines were built at the works of Messrs. Van de Kerchove, and are of the tandem compound two-crank four-cylinder horizontal type, with piston valve gear, driving direct the main shaft, which carries the magnet fly-wheel of the alternator. The engines are designed for steam at an initial pressure of 135 lbs. per sq. in., superheated to 275—300° C. The cylinders are 630 and 1,090 mm. in diameter,



Section of Power Station.

with a stroke of 1,200 mm., and the speed is 94 revolutions per minute. The maximum cyclic variation during one revolution is estimated at 1 in 400. The rotor of the alternator, which serves as fly-wheel, has a fly-wheel effect of 700,000 kgm.-m.

The normal output of each set of engines is 1,800 b.h.p., and the maximum for short periods is 2,800 b.h.p. The crank pins are 210 × 260 mm. long, and the main bearings 330 × 580 mm. long; the piston rod is 130 mm. in diameter. The piston valves are provided with packing rings, and have a very short travel in a vertical direction. The high pressure cylinders are not jacketed, but the steam is reheated in the receiver by means of live steam before entering the low-pressure cylinders, passing round the jackets of the latter on the way. Each set is provided with two surface condensers and pumps, the latter being driven direct from the main crank pins, as also are the boiler feed pumps.



General Arrangement of the System.

All the gauges and controlling gear for valves, pet-cocks, &c., are brought together at a point convenient for the supervision and control of the whole machine. In addition, the governors are equipped with electrical controlling gear by means of which the switchboard attendant can vary the speed in paralleling the alternators.

The latter were built by the Union Elektricitäts Gesellschaft, of Berlin, to whom we are indebted for assistance in the preparation of this article; they are designed for an output of 1,500 kilo-volt amperes at 6,600 volts, three-phase, with a frequency of 25 cycles per second. The rotating field magnet carries 32 poles, wound with bare copper coils separated by impregnated paper; damping rings of bronze are affixed to the polar expansions.

The armature core is provided with nearly closed grooves, wound with coils coupled up in delta fashion. The machines are designed for an efficiency of 96 per cent., with unity

power factor, at a load of 1,250 KW., and can support an overload of 50 per cent. for half an hour.

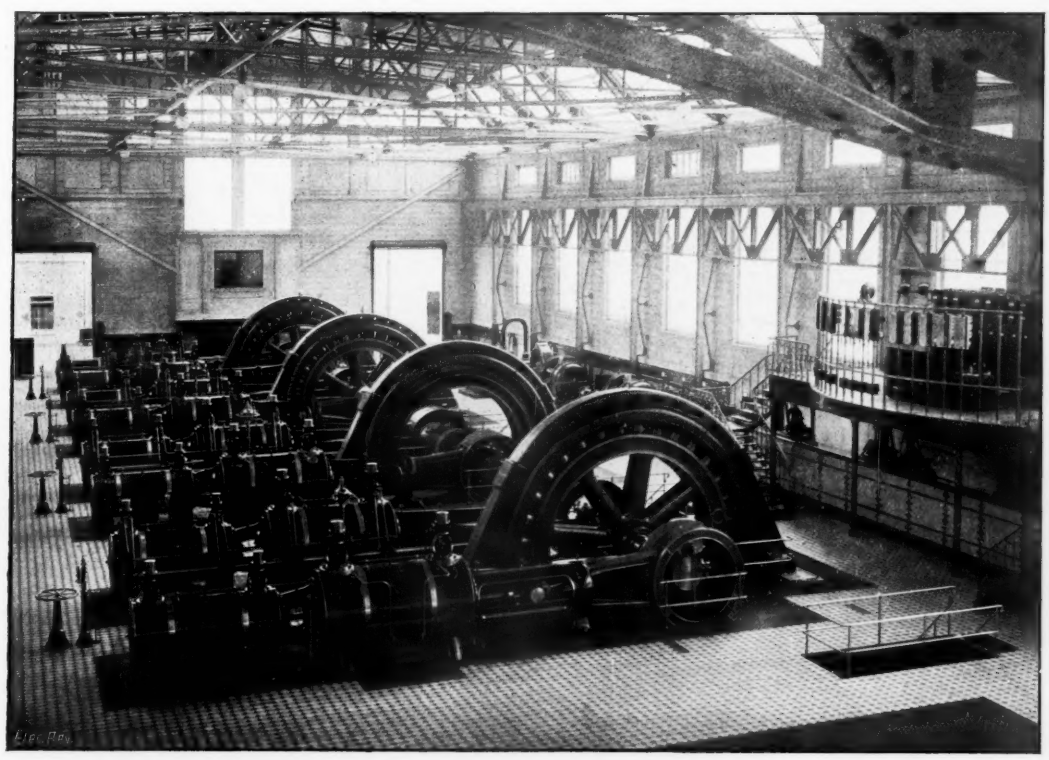
There are three eight-pole exciting dynamos, two driven by induction motors off the 6,600-volt mains, the third steam-driven; each of these has an output of 100 KW. at 110 volts, running at 250 r.p.m. A storage battery of 500 ampere-hours ensures the maintenance of operation in case of failure of the exciters, and is also used, with or without one of these, to supply the light and power circuit of the works, which is kept quite separate from the exciting circuits.

Exterior of Power Station.

The switchgear is controlled from an elevated platform, shown in our illustrations, by means of a switchboard carrying only low-pressure circuits; all the high-pressure apparatus is housed in separate compartments of masonry. The high-pressure switches are of the oil-break type, operated by small direct-current motors. The switchboard consists of three sections; one controls the whole of the direct-current plant for excitation, lighting and power of the works, and battery charging, and comprises three dynamo panels, one for the battery, three for the auxiliary plant, and one for the battery booster. Another section controls the high pressure switches in connection with the generators, feeders, induction motors driving the exciters, and sections of the bus-bars; the state of the respective switches is shown by pilot lamps. On this section are mounted also the hand-wheels of the rheostats of the exciters, and the switches controlling the motors which regulate the governors of the engines. The remaining section includes the measuring apparatus in circuit with the generators, feeders and motors, and the relays which actuate the automatic oil-break switches. This section is on the front of the platform, the instruments being mounted on copper tubes, between which the attendant has a clear view of the running plant. Besides the usual ammeters and voltmeters, phase-meters are used on the generator panels, and wattmeters on both these and the induction motor panels. A Lincoln synchronoscope is mounted over the centre of the board, to indicate the direction in which an incoming generator is out of phase, and the moment of synchronism.

The main bus-bars are divided by two oil switches into three sections, to each of which some of the feeders and generators are connected. The oil switches are of the type developed by the General Electric Co., U.S.A., and recently illustrated in our pages.

Eight feeders leave the generating station to supply three sub-stations, each of which supplies power to a separate portion of the tramway system. Two of these are situated in the old generating stations, making use of the existing low pressure D.C. feeders from these points; the third is situated at a convenient point nearly equi-distant from the others. All three are similarly equipped, save in the number of rotary converters installed.



General View of Engine Room.

The largest sub-station contains five 550-KW. converters of the six-phase type, each connected with three transformers of 200 KW. each. The latter reduce the primary pressure

of 6,600 volts to 410 volts for the converters, which generate direct current at 550 volts. The terminals of each transformer secondary are connected by means of slip rings with two diametrically opposite points of the armature. The transformers are cooled by air blast, and have an efficiency of 98 per cent. for a power factor of unity, while the converters have an efficiency of 94 per cent. under the same conditions.

The latter are compound wound, and can endure an overload of 50 per cent. for half an hour. They are normally started from the direct-current side, by means of a 75-KW. dynamo driven by an induction motor.

A storage battery of 60 ampere-hours capacity at 500 volts is used in parallel with the starting set, and serves also as a stand-by to the latter, besides providing power for lighting and for night work.

Each of the incoming feeders passes through oil-break switches on the way to the main bus-bars, from which leads are taken, again through oil-break switches, to the transformers. Reactance coils in series with the secondaries are provided, to enable the compound winding of the converters to take effect. The secondary coils are sub-divided so that, if desired, the converters can be started from the alternating side without excessive current rushes.

Brussels Tramways Power Station: Switch Gallery.

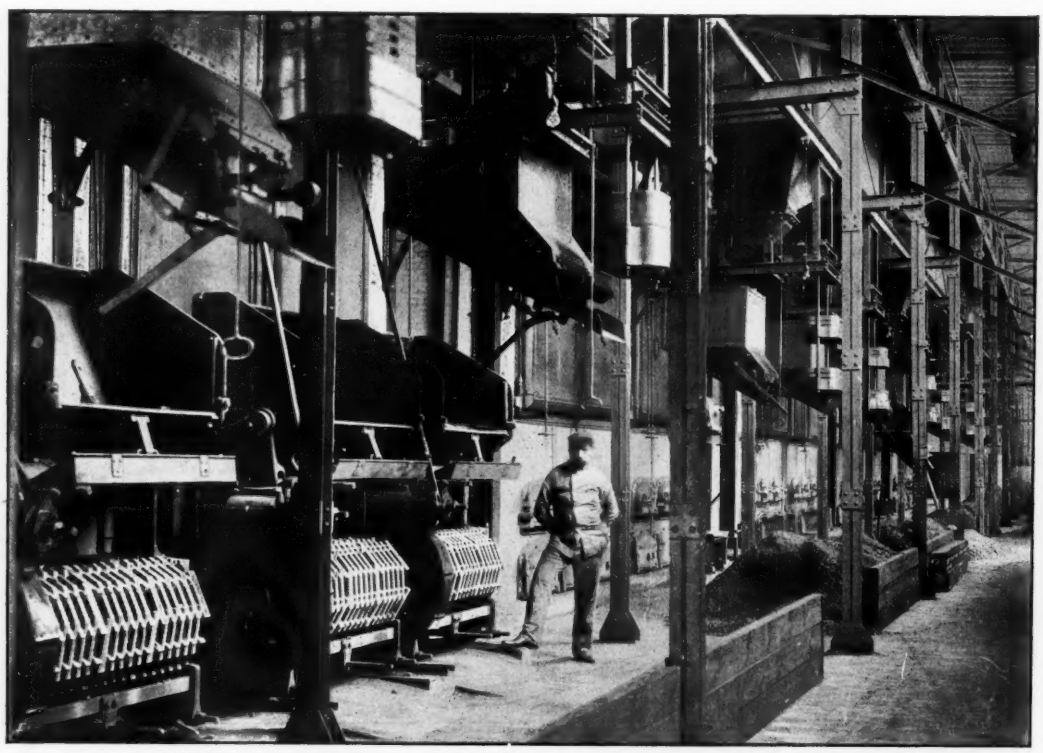
The switchboard includes separate panels for each feeder, the starter motor and generator, each side of the several converters, and for the battery. The apparatus mounted thereon is generally similar to that of the generating station, with the addition of low pressure direct current apparatus for the feeders to the tramways.

The system in general comprises a total length of about 50 miles of double track, partly on the overhead trolley and partly on the conduit system, with an ordinary service of 190 "trains" of 15 tons each, and a service of 295 trains of the same weight in times of heavy load; it is, therefore, an undertaking of considerable magnitude.

In conclusion, we may refer our readers who desire more detailed particulars to a paper read before the Société Belge d'Électriciens by Messrs. E. D'Hoop and J. Pedriali, and published in the *Bulletin* of that society in May last.

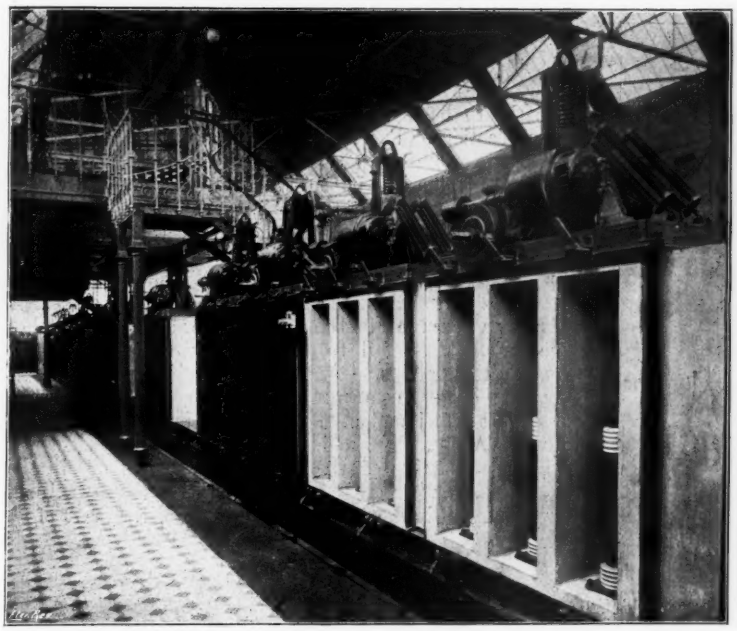
THE E.C.A. PROPOSED MODEL WIRING SPECIFICATION.

In a paper read by Mr. W. R. Rawlings on Tuesday evening before the Electrical Contractors' Association, a model specification for electric wiring and fitting was introduced and debated on. The specification was published in the last issue of the organ of the Association, and members had there-



Brussels Tramways Power Station: Interior of Boiler House.

fore had full opportunity for digesting its very simple construction, whilst no doubt many of our readers have been able to do the same. That some uniformity in wiring specifications is urgently wanted it is unnecessary to say; the wiring trade is absolutely at the mercy of the fads of consulting engineers, supply authorities, and insurance offices—to say nothing of the consumers and of—the contractors; and whilst this condition of affairs lasts wiring must ever remain a precarious business, and one which cannot be conducted on the lines of maximum efficiency. That the tendency to-day is towards standardisation is evidenced by the committee now sitting for the allied engineering trades, and also by the energetic attempt on the part of the Institution of Electrical Engineers to provide a uniform set of wiring rules. But when we come to wiring specifications, the task at once becomes more difficult, owing to the number of conflicting interests of a personal nature. Were the members of the Contractors' Association the only parties whose interests are involved, we should wish, naturally, nothing better than to see them combine to resist any other but their standard specification. But it cannot be denied—and we are sure Mr. Rawlings would be the first to admit—that the whole matter is one of give and take; and any settlement on the lines suggested must be by negotiation and compromise with the other side. This would not be difficult were the other side all of one opinion, and here will come the rub. Nevertheless, the E.C.A. deserve the thanks of the whole electrical trade and profession for the task which they have had the courage to tackle, and their good wishes for its happy fulfilment.



Brussels Tramways Power Station: High-Pressure Switch Gear.

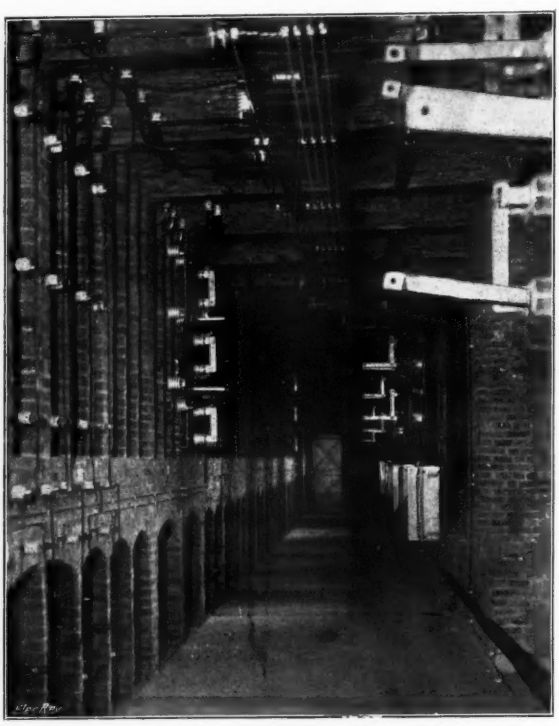
One of the chief grievances touched on by Mr. Rawlings was that by the very indefiniteness of many specifications the contractor is put to great disadvantage in competition. Those whose work it is to draw up specifications often appear to think that the number of pages is a measure of their own value as consultants, and verbosity flourishes at the expense of lucidity. Then, again, the author rightly complained of the way consulting engineers frequently ignore what is on the market and specify their own fads, thereby increasing the cost of the installation to the consumer. With commendable fairness he suggested that such action perhaps brings about improvements and maintains a high standard of work; but surely electrical fittings and accessories have been sufficiently standardised and most of their faults eliminated during the many years of the makers' experience, and the consultant who fails to realise these facts can be nothing else than pedantic.

That the contractor has another grievance in the surveyor and architect can also not be denied, especially when these gentlemen provide specifications copied from one kept in their offices for this purpose. Looking at the other side, Mr. Rawlings had a tilt at his own *confrères* who provide the innocent consumer with specifications which he cannot understand, and who, therefore, gives his decision in favour of the lowest cost, and possibly the worst specification.

Mr. Rawlings feels sure that if the E.C.A. can agree upon a specification, architects, surveyors and consumers will accept it, as well as certain general conditions; we observe that consulting engineers are not mentioned—no doubt an accidental omission, but it is with this class that the agreement will have to be made, and, with all due deference to the E.C.A., this should be admitted from the beginning. It is easy enough for one side to ultimately agree amongst themselves, and it would only be human nature for them to come to a decision favouring their own interests. But the consulting engineer represents the consumer and his interests, and, therefore, it is a clear case for compromise. For instance, some of the suggestions thrown out for the benefit of consulting engineers (we might rather say, of the contractors) will certainly require modification. It seems unnecessary to provide travelling expenses for the contractor if the site is more than 10 miles from his office; the contractor should include this in his price, and if he loses the

Brussels Tramways: Converter Sub-station.

job because another contractor is nearer, then he will be more lucky when the other contractor is further off another job. He must take the long with the short. Again, if firms are invited to tender, it is certainly unreasonable to ask for a

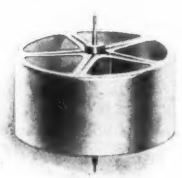


Brussels Tramways Power Station: High Pressure Cable Subway.

bank note to be enclosed with their offer; but if the competition is an open one to all comers, the proviso is, we think, quite necessary. Of course, the suggestion that contractors should obtain all goods is the *raison d'être* of the E.C.A.; certainly a stipulation might be made that any goods provided by the consumer or his agent, should be the subject of a special arrangement as to fixing, or a commission might be allowed the contractor on their invoiced value. We quite agree that the contractor should be protected against the consumer in the matter of preventing him from completing a job, and also for non-payment on presentation of certificates. But how this is to be enforced without a stamped agreement, we fail to see, and there will always be contractors willing to waive such conditions. Speaking generally, there is no reason why electrical contractors should work under other conditions of contract than builders, decorators, furnishers and other tradesmen, or why they should have any special considerations as to payment. We think it is largely a matter to be settled from within; let them observe the methods of the other trades, and we shall be surprised if they do not find a solution of the problem.

As to the technical part of the specification, the clauses as set forth appear to be based on all that is best and necessary, and to eliminate all the unnecessary verbiage with which so many consultants' specifications are now adorned. Under the circumstances it is perhaps difficult to criticise what is the result of so many years' experience; but there are a few remarks to be made which may possibly clear up certain misconceptions. For instance, it is stated that "the area of the wires to be such that the current density shall not exceed 1,000 amperes per sq. in.," whereas at the end we are told that "the whole of the work . . . . shall comply with the rules of the Institution of Electrical Engineers," in which the above standard of density is not recognised. Speaking of Simplex tubes, the specification reads: "The whole to be so arranged with junction boxes as to allow *as far as possible* the wire being drawn in or out." The italics are ours, as we fail to see why there should be any qualification. A tube system should, if proper work is carried out, be a draw-through system; otherwise the cost of junction boxes, &c., may as well be saved. Again, why should "wall plugs, bracket pendants, wiring and fixing of the same," not be included in the specification? Surely this seems a rather curious condition.

Dealing with the fittings and accessories, the heart of at least one supplier will rejoice at the stipulation that lamps are to be of British manufacture. But why not holders, wires, ceiling roses, fittings, and, in fact, all material used on the job?



Rotor of Type "K" Meter.

The lamp stipulation is an interesting one, though, and we wonder how many contractors will be able to conscientiously carry it out unless it be made a question of agreement as between the E.C.A. and the E.M.A. And then those members of the latter who do not make lamps themselves will rightly want some other concession. Taken as a whole, we should advise, perhaps, a little more detail, even at the sacrifice of some brevity, but this part of the specification should admirably serve as the basis of the final standard specification; as the terms of reference, in fact, for the committee which we hope will be formed for the purpose.

As to the general conditions, not having them before us

Single-phase Induction Integrating Wattmeter, Type "K." (See opposite page.)

we are unable to express any opinion. The schedule of prices is a simple matter, which can easily be settled; that submitted appears as clear as should be required by the most exacting. In conclusion, Mr. Rawlings is to be congratulated on the tactful, though brief, manner in which he introduced the subject, and the further action of the E.C.A. will be watched with interest by all concerned. We cannot refrain also from sympathising with the author in his views on the large number of different voltages in the London area, and if the E.C.A. carry out his suggestion to approach the Board of Trade, another step will be made—a very small one, we fear—in the direction of standardisation and efficiency. But the task they have already undertaken would be as nothing compared with this one, in spite of the recently issued report of the Committee on Engineering Standards. That it would receive the support of all lamp and motor makers we are sure, for, as Mr. Rawlings aptly says, this want of uniformity is without doubt detrimental to the best interests of the public and of all those engaged in the electrical industry.

SINGLE-PHASE INTEGRATING WATTMETER.

The induction type of watt-hour meter, from the earliest days of the induction motor principle, has received close attention, and has passed through many stages of evolution calculated to remove its defects and to increase its accuracy and range of application. Among its most serious drawbacks were its inaccuracy on inductive loads, and its small torque. A new pattern of induction meter has recently been introduced by the British Thomson-Houston Co., Ltd., and styled "Type K," which, it is claimed, exhibits marked improvements over previous meters of this form. The general appearance of the meter, both open and closed, is shown by the accompanying illustrations. The meter is remarkably small, occupying a space only $6\frac{3}{4}$ in. wide × $8\frac{3}{4}$ in. high, and weighing only 13 lbs., so that it is convenient to handle and unobtrusive in position. All the parts are interchangeable and are readily accessible, and great attention has been paid to simplifying the fixing and levelling of the meter; to this end, an ingenious modification of the well-known hole, slot and plane system has been adopted, the meter being supported at three points—one at the top, and one on each side at the bottom. At the top there is a vertical slot, while one of the lower attachments is hook-shaped; the third is a plain round hole, and in order to remove the meter only one screw—the one passing through this hole—has to be removed. The terminals are placed at the sides, near the top.

The front cover is an aluminium casting, which fits into a deep groove in the frame, lined with felt so as to be proof against dust and insects; the readings are taken through a single window in the front cover. The dials are direct-reading in kilowatt-hours, and are large and clear.

The rotating part consists of a seamless aluminium cylinder supported by a light spider on a vertical shaft, which rotates on a spring-supported sapphire jewel, of standard design, and readily interchangeable without affecting the adjustments of the meter.

The winding consists of two series coils, and a pressure coil connected in series with a reactance coil, by means of which the current in the pressure coil is made to lag practically 90° behind the line pressure. The combined action of the three coils produces a moving field, which exerts a torque upon the aluminium cylinder proportional to the power used at any moment.

The cylinder passes between the poles of a permanent magnet, which produces a retarding torque proportional to the speed, so that the resultant speed of the disc is proportional to the power, and the counting train, which is driven by a worm on the shaft, records the energy used in watt-hours.

A novel and important feature of the "type K" meter, is the fact that the rotating parts of the meter can be removed *en bloc* without in any way affecting the calibration of the meter, thus affording ready access to other parts. This is accomplished by removing the registering mechanism, which is securely held in place by two screws.

The meter is provided with a starting coil to overcome the slight mechanical friction of the instrument, and to ensure accurate registration on light loads. The position of this coil is adjusted by the screws A and B (shown in one of our illustrations), the speed of the meter being increased on light loads by loosening screw B and tightening screw A. When this adjustment has been correctly made for light loads, there is no risk of the meter "creeping" without load if the voltage of the supply circuit increases.

The meter is readily adapted to suit a change in the frequency of the supply, *e.g.*, from 100 to 50 cycles, or *vice versâ*. The change from high to low frequency is accomplished by closing the circuit at D (shown in one of the figures) by soldering the large copper wires together, while to change from low to high frequency the inverse operation is required—unsoldering and separating the ends of the wires. This is a valuable feature which, we believe, is entirely new, enabling the change to be made without removing any of the parts or returning the meter to the manufacturers.

The introduction of the simple and ingenious improvements outlined above appears to us to mark an important advance towards the evolution of the perfect meter, and the release of the station engineer from some of his many worries.

ELECTRIC TRACTION NOTES.

(*Continued from page* 741.)

Nottingham.—Speaking at a municipal election meeting last week, Alderman Brownsword, chairman of the Tramways Committee, made it clear that there was less likelihood than ever of an adoption of universal penny fares. He had been impressed by some Sheffield figures. He said that in Sheffield the experiment was made of universal penny fares, with the result that in five months the working expenses of the tram system, it was said, were increased by £4,748, whilst the returns remained stationary. On these figures, the Nottingham Tramways Committee's present intention to make no alteration in the existing scale of fares is strengthened. The present number of passengers carried weekly on the Nottingham cars is 585,000; that is the minimum figure.

Paisley.—A start has at last been made with the conversion of the Paisley tramway system from horse haulage to electric traction. On Monday morning the work was commenced at the east end of the line, where the junction with the Glasgow Corporation system will be effected. The estimated cost is £320,000. The main line from the junction with the Glasgow Corporation system will run right through to Johnstone, and be a double line. The branch lines will also be double when possible. The line to Johnstone will be completed first by the end of March next, it is expected, and the whole system by June.

St. Helens.—The T.C. and the local tramways company seem fated to be in a state of constant tension. First, trouble arose over running terms, then over goods traffic terms. Lately, trouble arose over track and traction. The Council complained that the company's car-wheels were bad and were spoiling the track, and the company complained that the Corporation track was bad and was spoiling the car-wheels, and at that the particular trouble still stands. The company has just induced the Tramways Committee to reduce the capital amount on which the company pays interest by £400, but the Committee will set off as from the beginning of November the claim by the Corporation against the company for repairs to the overhead equipment, against the claim of the company for stoppages through the failure of the Corporation to supply the necessary power for working. It is to be hoped that this arrangement will be satisfactory to both parties.

Soothill Nether.—The U.D.C. has decided to apply for powers to construct tramways and work or lease the same, to purchase land, and erect an electricity station and refuse destructor, and to widen certain streets, this work being necessary if the tramways are put down. Dewsbury and Ossett Corporations are also seeking powers to construct tramways, and it is intended that the line shall run from Dewsbury Market Place, through Soothill Nether, and forward to Ossett Market Place. The plant at Soothill Nether is intended to supply electricity to private customers and energy for the tramways in the Council's area.

Walsall.—On Thursday last week a trial trip was run on the new lines laid down by the Corporation. These, together with the existing lines in the borough, will commence running on January 1st next. The car was run over all three new lines, one to Walsall Wood being nearly four miles in length, that on the Birmingham Road being two miles long, and the third to Willenhall being between two and three miles in extent. Altogether the Corporation will, at the end of the present year, be responsible for the working of over 12 miles of track. The tramways are now ready for the Board of Trade inspection. The total expenditure involved is estimated at about £150,000.

Southend.—Objections to the confirmation of the Southend and Colchester Light Railways Order must be lodged with the Board of Trade by November 21st.

West Bromwich.—On Tuesday Colonel Von Donop made a Board of Trade inspection of the lines which have been laid in Slim Lane and Bromford Lane.

TELEGRAPH AND TELEPHONE NOTES.

Imports of Foreign Telegraph Cables.—The imports of foreign telegraph cables and apparatus into this country last month amounted to only £2,668, as compared with £8,381 in August last, bringing up the total for the first nine months of the year to £44,780.

International Telegraph Conference.—According to the *Times*, the Government of India have issued a statement outlining the revised convention and regulations adopted by the London International Telegraph Conference in May last, which are to come into force on July 1st next. The new arrangements, including the decision not to make the official vocabulary compulsory, are described as according with the wishes and interests of the commercial community and the public generally in India, and as being calculated to put an end, once and for all, to the constant disputes as to the admissibility or otherwise of doubtful code words. Under the convention such words, which may be real or artificial, must be composed of syllables capable of pronunciation according to the use of language in German, English, Spanish, French, Dutch, Italian, Portuguese or Latin; and the words must not exceed ten letters according to the Morse alphabet. Conbinations not fulfilling these conditions will be considered as letter ciphers, and will be charged accordingly, viz., at the rate of five letters per word. Words formed by joining two or more plain language words, contrary to the usage of language, are inadmissible.

Wireless Telegraphy.—Prof. Silvanus Thompson lectured on Tuesday at the Hampstead Conservatoire on wireless telegraphy. In the course of his lecture he expressed the opinion that the importance of most of the present experiments was exaggerated, and that the trail of the financier had been the bane of wireless telegraphy.

CONTRACTS OPEN AND CLOSED.

OPEN.

Barrow-in-Furness.—The Corporation wants tenders for the completion of the electric lighting installation at Hawcoat and Walney Police Stations and the Pig Slaughtering Hall and Lairage at the Public Abattoirs. Particulars at the borough engineer's office, Town Hall.

Beckenham.—November 9th. Electric wiring under free wiring scheme. See "Official Notices" October 16th.

Bermondsey.—November 9th. Low-tension feeder, and arc lighting, cables; arc and incandescent lamps, standards, switchboxes, &c. See "Official Notices" October 30th.

Blackpool.—November 14th. One 450-KW. traction set (vertical triple-expansion engine and multipolar generator). See "Official Notices" October 23rd.

Brighton.—December 7th. Six water-tube boilers, piping, tanks, and sundry other steam plant, for the Southwick power station. See "Official Notices" to-day.

Ceylon.—December 1st. The Ceylon Government is inviting proposals from those willing to enter into a contract for the supply of electrical energy to the various offices, buildings, and premises of the Government, for a term of years commencing on or about August 1st, 1905. Proposals must be delivered, under seal, at the office of the Colonial Secretary, Colombo, on or before December 1st, 1903. The *Gazette* containing a full notice may be seen at the Commercial Intelligence Branch of the Board of Trade, 50, Parliament Street, S.W.

Chorley.—The Corporation invites offers for its electric lighting order. See "Official Notices" October 23rd.

Dartford.—November 9th. The Metropolitan Asylums Board wants tenders for a telephone system for Darenth Asylum. See "Official Notices" to-day.

Dublin.—November 14th. Arc lamp carbons. See "Official Notices" to-day.

Epsom.—November 11th. The U.D.C. wants tenders for the supply of certain cables. H. F. Foster, resident engineer.

Glasgow, &c.—May-Oatway Fire Appliances, Ltd., are inviting tenders for wiring for a number of installations of their fire alarm system. See "Official Notices" October 30th.

Great Western Railway.—December 7th. Water-tube boilers, engines, three-phase generators and auxiliary plant, for the Park Royal power station. See "Official Notices" to-day.

Harrogate.—November 16th. High tension mains. See "Official Notices" October 30th.

Hornsey.—November 30th. Meters, indicators and fuse-boxes. See "Official Notices" to-day.

Johannesburg.—November 16th. Gas producer plant; gas engines and dynamos. Alternative:—Water-tube boilers, steam engines or turbines, electric generators, and other plant. For the municipal tramways and electrical supply scheme. See "Official Notices" August 28th.

Kilmarnock.—November 18th. Lancashire boilers; engines and dynamos; crane; battery; and switchboard for electricity scheme. See "Official Notices" October 9th.

Kirkcaldy.—November 23rd. One 400-KW. steam engine and dynamo for lighting and traction. See "Official Notices" to-day.

Leeds.—November 13th. Forty-five tons of piping and valves for the electricity works. See "Official Notices" October 23rd.

Maesteg.—The Council invites proposals from those willing to take over electric lighting powers for the district. See "Official Notices" to-day.

Plymouth.—November 14th. The Corporation is inviting tenders for an electric lighting installation for the Borough Asylum, Blackadon. Specifications, &c., from Mr. E. G. Okell, borough electrical engineer.

Radcliffe.—November 14th. Lighting and traction switchboards and accessories; rail bonds for the U.D.C. See "Official Notices" October 23rd.

Sweden.—Tenders are at present being invited by the municipal authorities of Wisby for the electric lighting of the town.

Swindon.—November 16th. Steel poles, overhead equipment for tramways, arc lamps, &c., for the Corporation. See "Official Notices" to-day.

Swindon.—November 23rd. Traction switchboard and feeder cables. See "Official Notices" to-day.

Sydney (N.S.W.).—December 30th. Tenders will be received at the office of the Deputy Postmaster-General, Sydney, New South Wales, from persons desirous of contracting for the supply to the Departmental Stores, Sydney, of telegraph, telephone, and electric light material. Specifications, &c., may be seen, and tender forms obtained at the General Post Offices, Sydney, Melbourne, Brisbane, Adelaide, Hobart and Perth. Samples may also be seen at Sydney, Melbourne, Brisbane and Adelaide.

Wednesbury.—November 20th. Electric wiring of public buildings. See "Official Notices" October 23rd.

Whitehaven.—November 18th. Electric wiring, &c., for the new infirmary. See "Official Notices" to-day.

CLOSED.

Epsom.—The U.D.C. has accepted the following tenders:—

Reason Manufacturing Co., for 50 meters.
Mather & Platt, Ltd., for oil filters.
Meldrum Bros., Ltd., for a refuse destructor, £2,750.

Halifax.—The T.C. has accepted the tender of the Electric Construction Co., Ltd., of Wolverhampton, for the supply of a 750-KW. direct current dynamo coupled to a Pollit & Wigzell horizontal cross-compound engine, for £6,631.

Hull.—The Corporation Telephones Committee has accepted the tender of the Ericsson Bell Telephone Co. for the supply of telephone instruments and switchboard, at £2,757.

Ilford.—The U.D.C. has accepted the tender of Messrs. Milnes, Voss & Co., for nine roof-coverings for tramcars, at £70 10s. per car.

Nelson.—The tender of Messrs. Bruce Peebles & Co., of Edinburgh, for the supply of a 400-KW. engine and dynamo for the electricity works, has been accepted by the T.C.

Preston.—The T.C. has accepted the tender of Messrs. Dick, Kerr & Co., Ltd., for the supply of 30 electric cars at £472 each. The Tramways Committee recommended the acceptance of a further tender by the same firm for certain permanent way and overhead construction work, with the Lorain Co.'s special equipment as specified, for the sum of £80,592. This tender was, however, referred back to the Tramways Committee.

London.—The Highways Committee on Tuesday reported to the L.C.C. on the tenders received for four 5,000-H.P. engines required for the Greenwich tramways power station, and recommended that of Messrs. John Musgrave & Sons, Ltd., of Bolton, for acceptance. The following is a list:—

Fullerton, Hodgart & Barclay, Ltd., Paisley (incomplete)	£86,817
Maschinenfabrik Buckau Aktien-Gesellschaft, Magdeburg (not to specification)	58,871
Cole, Marchent & Morley, Ltd., Bradford	84,921
Wallsend Slipway and Engineering Co., Ltd., Wallsend-on-Tyne (German steel)	88,525
Do. do. (English steel)	92,525
A. Borsig, Berlin (incomplete)	92,995
Davey, Paxman & Co., Ltd., Colchester	96,693
John Musgrave & Sons, Ltd., Bolton	96,713
Ferranti, Ltd., Hollinwood, Lancs.	99 250
Allis Chalmers Co., London	99,750
Yates & Thom, Blackburn	100,680
Aktieselskabet Burmeister & Wains, Copenhagen	105,688
Gourlay Bros. & Co., Dundee	107,168
D. Stewart & Co. (1902), Ltd., Glasgow	109,068
Do. do. do. (alternative)	105,492
Willans & Robinson, Ltd., Rugby	131,857

The Committee reported:—

"The tenders have been carefully examined by the Council's electrical engineer, and we have had before us his report upon them. As the result of our consideration of the matter, we are of opinion that the tender of Messrs. John Musgrave & Sons, Ltd., amounting to £96,713, should be accepted. It was not possible to consider the first two tenders, as that of Messrs. Fullerton, Hodgart & Barclay, Ltd., was incomplete, while the second lowest tender was not in accordance with the Council's specification. The next lowest tender amounts to £84,921 10s., or £11,791 10s. below that of Messrs. Musgrave & Sons, which, it is suggested, should be accepted. As the difference between the two tenders is about 12 per cent, we have given very careful consideration to the course which should be taken in the matter.

"Certain details of construction of the engines were left to the tenderers to decide, and we have, therefore, in considering the matter, borne in mind the relative advantages of the various proposals submitted by the firms who have tendered, having regard to the Council's requirements. Moreover, in view of the vital importance of the engines to the success of the tramways undertaking, we have also felt compelled to take into account the experience and qualifications of the firms submitting tenders to undertake so large a work, as it involves the largest order for engines which has ever been given by a municipal body. In order that there should be no risk of failure, and that the best possible form of construction should be secured, we are of opinion that the extra expenditure involved by accepting the tender of Messrs. Musgrave & Sons is fully justified, as it is essential to the successful completion of the large and costly tramway works which the Council has in hand that the most satisfactory results should be obtained from the engines.

"Messrs. Musgrave & Sons have submitted the names of certain firms to whom they propose to sublet different portions of the work, and we are advised that no objection need be raised to that course. The necessary expenditure is provided for in the estimate approved by the Council on July 21st, 1903 (p. 1213), for the provision of plant at the Greenwich generating station. We recommend:—

"(*a*) That, subject to the result of the usual inquiries proving satisfactory, the tender of Messrs. John Musgrave & Sons, Ltd., be accepted for the supply and erection, for the sum of £96,713, of the four 5,000-H.P. steam engines required for use at the electricity generating station now being established at Greenwich, in connection with the electrical working of the Council's tramways.

"(*b*) That, in connection with the supply of the engines referred to in the foregoing resolution, Messrs. John Musgrave & Sons, Ltd., be allowed to sublet the following portions of the work to the undermentioned firms or to such other firms as may be approved by the engineer under the contract, namely, (1) to Messrs. John Brown and Co., Sheffield, the manufacture of the heavy forgings; (2) to Messrs. J. Webb & Co., Bury, the manufacture of the light forgings; and (3) to Messrs. W. Jessop & Sons, Sheffield, the manufacturers of the steel castings."

Railway Signalling.—A Darlington correspondent of a London paper says that the Central South African Railways have placed important contracts for the equipment of the lines in the Orange River Colony with the Tyers Electric Signalling System at an estimated cost of over £49,000.

South America.—Messrs. Mather & Platt, Ltd., have sublet the contract for 44 motor-starting switches, from 1½ B.H.P. to 42 B.H.P., and 44 double-pole switches, to Messrs. Bray, Markham and Reiss, Ltd.

Wolverhampton.—The Corporation has accepted the tender of Thos. Parker, Ltd., for the supply of a set of balancers at £196, subject to their agreeing to supply a similar set at the same price at a later period, if required.

The electrical engineer has been instructed to invite tenders for the supply of six double-deck cars, and the chairman and deputy chairman of the Tramway Committee and the electrical engineer, have been authorised to accept such tender or tenders as they shall deem advisable.

The Corporation have accepted the tender of Messrs. Joseph Evans & Sons, at £1,293, for the supply of surface condensing plant at the electricity works.

Wood Green.—The D.C. has placed a contract with Henley's Telegraph Works Co., at £7,678, for certain work in connection with the electricity supply scheme.

FORTHCOMING EVENTS.

Saturday, November 7th.—At 7 p.m. Salford Science Students Association. Meeting. Questions for discussion:—
1. What is the best form of condenser for highly superheated steam?
2. The keying of bosses to shafts.
3. What are the possibilities of Aerial Transportation between England and France?
4. Is it advisable to use high pressure steam, and what are the drawbacks experienced in present day practice?

Monday, November 9th.—At 8 p.m. Institute of Marine Engineers. Meeting.

At 7.30 p.m. Institution of Mechanical Engineers (Graduates' Association). Paper by Mr. W. H. A. Robertson on "Heating and Ventilating on the Plenum System."

Tuesday, November 10th.—At 8 p.m. Institution of Civil Engineers. Paper on "Tensile Tests of Mild Steel, and the Relation of Elongation to the Size of the Test-Bar," by Prof. W. C. Unwin.

At 8 p.m. Institution of Electrical Engineers (Glasgow). Meeting.

Thursday, November 12th.—At 8 p.m. Institution of Electrical Engineers. Meeting. Inaugural address by Mr. Robt. K. Gray.

Friday, November 13th. — Electro-Harmonic Society Concert. King's Hall, Holborn Restaurant. Ladies' night. Mr. R. K. Gray will preside. The programme will include selections by an orchestra.

At 8 p.m. Physical Society. South Kensington. "Means for Electrifying the Atmosphere on a Large Scale," and "An Arrangement for Driving Mercury Pumps," by Sir Oliver Lodge.

Saturday, November 14th.—West Hartlepool Scientific Society. Mr. W. C. Borrowman on "The Absurdities of the present System of Measures."

At 7.30 p.m. Glasgow Technical College Scientific Society. Paper by Mr. A. Govan on "Motor-Cars."

NOTES.

The Institution of Electrical Engineers.—We wish to remind our readers that the Inaugural Address of Mr. Robert K. Gray, as President of the Institution of Electrical Engineers, will be delivered at the opening meeting of the session, to be held in the rooms of the Institution of Civil Engineers at 8 p.m., on Thursday, November 12th. The Annual Dinner will be held at the Hotel Cecil on Wednesday, December 10th.

Magnetic Disturbance.—A great deal has been appearing in the daily newspapers this week with reference to a magnetic storm which made itself felt on Saturday and Sunday last. The *Times* gives the following account of the effects of the occurrence upon the telegraph cables:—"Considerable delay was occasioned in the working of the lines and cables of the cable companies on Saturday by an exceptional electrical disturbance or storm, which is described as the worst experienced for the past 14 or 15 years. A Press representative, upon inquiry at the different cable offices in London, was informed that on Sunday the wires appeared to be working with very few interruptions. An operator employed by one of the cable companies stated that, after the first interruption, his firm added more battery power to their currents, and 'cut off' Penzance as the station for picking up 'earth,' substituting 'artificial earth' in London. In the ordinary way 'earth' is picked up at Penzance, but, as a means of combating the disturbance, several technical experiments were made. The one mentioned proved successful, and they were able to continue working, but at a reduced speed."

Mr. Walter Sidgreaves, director of Stonyhurst College Observatory, telegraphed to the same newspaper on Monday night:—"The disturbed state of the telegraph lines on Saturday, which for a time interrupted communication between London and Paris, was accompanied by the greatest magnetic disturbance recorded by the Stonyhurst photo-magnetographs, which have furnished a practically continuous record since 1867. The disturbance was remarkable for the multitude of wide oscillations of very short periods, indicating great and rapid changes of horizontal direction and force. The magnetic storm began at 6 a.m. on Saturday and ended at 5 a.m. on Sunday. The beginning and ending were more or less abrupt, but the storm was preceded and followed by a period of about 9 hours of small, rapid oscillations. The greatest oscillation of horizontal direction was 2 deg. 46 min., but the greatest change of horizontal force is unknown, the spot of light having been off the photographic paper on both sides many times. The surface of the sun was marked by two spots, a new one not far from the centre and a spot near the eastern limb of the well-known double form. Grouped together they are about three-fifths the area of the great spot of last month. The magnetic storm of Saturday was incomparably greater than that recorded during the first passage of the great spot over the solar disc."

The Controller of the Central Telegraph Office, in the course of a Press interview, said that "the disturbance was first noticed about sunrise on Saturday, and it appeared to have been general all over Europe and North America. The main storm disappeared about five or six o'clock the same evening—just too late to save the situation for the football reports. The storm was at its worst in the afternoon, but there was a slight aftermath later in the evening, not sufficient, however, to cause any serious interruption. There was an undoubted connection between this phenomenon and the 'sun spots.' If the earth currents had flowed continuously in the same direction, we could have got over the difficulty by neutralising them, but as they were continually changing we found that impossible."

The Speed of Electric Cars.—Several of the drivers employed by the London United Tramways Co. again appeared at West London on Monday in answer to the summons against them for driving their cars at an excessive rate of speed. Our readers will remember that an adjournment was made some time ago to allow speed tests to be made. The Board of Trade, it appears, nominated Col. M. H. Purcell to make these tests, and the results thereof were placed before the Court on Monday. Col. Purcell had a free hand with regard to the experiments. He posted an assistant at the generating station, and Mr. Parker, of the London Athletic Club, took the times. He measured off a distance of 1 furlong at Goldhawk Road, and then tested the cars. With a flying start the following times were made:—

No. 272.—First trial: 34⅘ sec.—13·006 miles an hour; second trial: 34¼ sec.—12·93; third trial: 32—14·06.

No. 75.—First trial: 34⅘ sec.—13·03; second trial: 36⅖ sec.—13·47; third trial: 36—12½.

No. 60.—First trial: 35⅕ sec.—12·78; second trial: 36⅖ sec.—12·29.

No. 173.—First trial: 33⅗ sec.—13·39; second trial: 36⅖ sec.—14·8.

Col. Purcell in evidence stated that these figures showed the highest speeds attained by the cars. Mr. Ford came up soon after the first test was taken, and he said that unless the car was in exactly the same condition—number of passengers, &c.—it was no test at all. Mr. Ford then withdrew. The statement that Mr. Ford was not admitted to the test was untrue. Witness also tested two other cars that came along, and the highest speed was 14·5 miles. He said he was not an expert. He was also asked whether he had taken steps to ascertain if anything had been done whereby the speed of the cars engaged in the test might be lowered, and he replied that he took every precaution to get correct results. Having ascertained the average voltage at the generating station, he was of opinion that nothing was done to interfere with the test.

Edward J. Smith, an electrical engineer, who was at the generating station, said he did not think the system could have been interfered with.

Mr. J. C. Robinson, the managing director, said he gave instructions that the test was to take place under normal conditions. He told Mr. Ford that he did not like the suggestion that the machinery had been interfered with. He had tested the cars in question, with practically the same results. He denied that the cars could exceed 30 miles an hour. Mr. Rose, replying to Mr. Muir, said his difficulty was that evidence had been given as to the speed which was over the limit. Mr. Ford then called Colonel Crompton, who said that, seeing there was no instrument on the car he was on to test the speed, he advised Mr. Ford to withdraw. He had tested the cars on other occasions and they had exceeded the figures given. Three other witnesses gave similar evidence, and the case was adjourned.

Indian Electrical Volunteers.—The *Rangoon Times* says that the Electrical Engineer Company to be formed in connection with the Madras Artillery Volunteers will consist of two officers, seven non-commissioned officers, 37 sappers, eight engine drivers, 24 electricians and 12 telephonists. The company will be instructed by officers and and non-commissioned officers deputed from the Indian Submarine Mining Corps.

Victoria Falls.—It is stated that Mr. Francis Fox, of Sir Douglas Fox & Partners, has been visiting America in connection with water-power development, and has just returned from Switzerland on a similar visit, where he has seen some of the most important hydro-electric installations. His visits have been made in connection with the large power plant shortly to be erected at the Victoria Falls, on the Zambesi River, by the African Concessions Syndicate, in which the Chartered Co. is largely interested.

A Birmingham Electric Power Transmission Plant.—The Birmingham, Tame and Rea District Drainage Board, on the advice of their engineer, Mr. John D. Watson, have decided to instal a complete electrical power transmission scheme, and to this end have given their sanction to an application being made to the Local Government Board to borrow £14,000, for the purpose of erecting a boiler house, electric generating station, overhead transmission line, motors, pumps, transformers, &c. In the last session of Parliament, authority was granted to the Birmingham, Tame and Rea District Drainage Board to sell two acres of land to the City of Birmingham for the purpose of constructing a refuse destructor thereon. In payment for this land the City of Birmingham undertakes to generate steam 24 hours a day in sufficient quantity to develop 175 B.H.P. when utilised in a high-speed engine condensing. The Drainage Board propose to utilise this power in generating electric power in the form of three-phase current at the generating station, which will be erected at Saltley, near Birmingham, and transmit the power a distance of five miles over the Drainage Board's Outfall Works and Irrigation lands at a transmission pressure of 2,300 volts. There will be two generating sets, consisting of two high-speed engines by Belliss & Morcom, each of which will be direct connected to one British Thomson-Houston revolving field generator, the latter generating three-phase current at 50 cycles and 2,300 volts. This current will be led direct to the overhead transmission line, which will be tapped at eight points along the route, at each of which a sub-station will be erected, containing the necessary step-down transformers for transforming the pressure from 2,300 volts to 200 volts.

At four of the sub-stations, centrifugal pumps direct connected to British Thomson-Houston standard induction motors will be installed for pumping purposes, replacing separate installations of steam-driven pumps, the transport of fuel and water to which is necessarily an expensive item; these pumps will be placed at different positions on the Board's estate, where the level of the land is such as to necessitate pumping the water on to the land from the main culvert, which runs throughout the length of the estate. There are 14 motors in all, ranging from 2 to 28 H.P., a number of which are used for operating machinery on the different farms situated on the Board's estate, and also for operating distributors and such machinery of a special nature as is used in connection with the treatment of sewage. The lighting of the principal buildings situated on the Board's estate will also be carried out from the same generating station. This scheme, which, as applied to pumping in connection with sewage disposal, is a pioneer scheme, is entirely due to the initiative and enterprise of the engineer, Mr. John D. Watson. The contract for the complete equipment of the generating station and sub-stations and the erection of the transmission line, together with the contracts for the supply of all motors and accessories, has been provisionally placed with the British Thomson-Houston Co., Ltd., of Rugby, and work will be commenced immediately when the Local Government Board have sanctioned the necessary loan.

Tests of Motors Driving Machine Tools.—In a recent number of the *American Electrician* some data are given by Mr. M. F. Moore of the power taken by certain machine tools in the Morden Frog and Crossing Works, Chicago, from which we abstract the following figures:—

Size of motor, 220 volts.	Starting current.	Starting voltage.	Running current light.	Running current loaded.	Average developed H.P.	Tools operated by motors.
5 H.P.	55½	90	7½	7½	3·82	Radial drill—Nile's universal.
20 H.P.	163	125	22½	47½	17·84	14-in. pony planer; 14-in. pointer; band saw; universal saw; lathe; grindstone.
10 H.P.	87	85	12½	27	8·93	Punch; three-single spindle drills; emery wheel.
15 H.P.	125	175	15	40	15·30	2 — 15 ft. 36 in. × 36 in. Seller's planers.
5 H.P.	52½	100	4	8½	4·34	Rail bender—Am. Bridge Works.
5 H.P.	52½	100	4	8½	4·34	Rail bender.— Am. Bridge Works.
5 H.P.	50	100	7½	14	5·65	Three-spindle rail drill.—Newton.
5 H.P.	50	100	7½	14	5·65	Three-spindle rail drill.—Newton.
15 H.P.	125	175	15	40	15·30	5-in. Beaudry hammer; 5-in. Ajax forging machine.
5 H.P.	48	103	4	11½	7·40	Punch and shear.
30 H.P.	280	115	65	65	33·16	No. 3 Root high-pressure blower, 3 lbs. pressure.
50 H.P.	412½	100	32½	182	74·00	High-speed saw cutting 85-lb. A.S.C.E. rail in 37 sec.
50 H.P.	450	150	50	90	71·42	13 switch planers; 33 spindle drills three milling saws; one punch and shear; one bulldozer; one rail bender; five single spindle drills; one bolt cutter; one saw grinder; three lathes; four shapers; 2 emery wheels; 1 shear.
50 H.P.	—	—	50	90		

The motors are all rated at 220 volts, and the speeds range from 1,120 revolutions per minute in the small sizes to 850 in the 50 horse machines.

Physical Society.—At the end of last session it was decided to hold the meetings alternately in the afternoons and evenings, and to change the place of meeting from the Chemical Society to the Royal College of Science, where the facilities for experimental demonstration are very complete. The first evening meeting will be held on Friday, the 13th inst., at 8 p.m., when Sir Oliver Lodge will describe and illustrate by experiments (1) means for electrifying the atmosphere on a large scale and (2) an arrangement for driving mercury pumps.

The Brighton Tramways Committee and Provision of Trucks.—The recent action of the Brighton Tramways Committee in disqualifying a tender of the Brush Electrical Engineering Co. on the ground that they had not complied with the specification, requires further elucidation. It appears that the specification of the Brighton Corporation engineer was for "Brill or Peckham trucks," which are manufactured in America; the Brush Co. being publicly invited to tender, offered to supply the articles required, constructed at their own works at Loughborough, and the Tramways Committee appear to have rejected the tender on the ground that it was not according to specification—that is to say, for Brill or Peckham trucks.

This action has very naturally created considerable indignation among the employés of the electric traction department of the

Brush Electrical Engineering Co., who passed the following resolutions at a meeting held at the Falcon Works, Loughborough, on the 2nd inst.

"1. That this meeting, having heard that in several towns it is the custom to exclude British firms from putting in tenders for trucks in competition with foreign makers, respectfully appeals to members of tramway committees and other buyers of cars to give fair play to an industry on which the welfare of so many of their countrymen—not only ourselves and our families, but other workers concerned in the preparation of the material—is absolutely dependent.

"2. That, while having no right or wish to interfere with the actual placing of orders, we urge that in our own country it is unjust that British truck makers should be barred from opportunities of selling goods which are the product of British labour.

"3. That we protest against any suggestion that foreigners can claim superiority or even equality in any branch of steel work; and we are confident that, with fair and open competition, foreign made electric traction trucks would soon fail to find any market whatever in this country, and that employment would then be provided for a large number of additional men in this industry.

"(Signed) H. Davis, *Chairman (Erector)*,
"I. Cramble, *Secretary (Fitter)*."

Unless there has been some misunderstanding as to the intention of the specification in question, the action of the Brighton Corporation Tramways Committee is objectionable, not merely from a patriotic but also from a business point of view.

If they meant that what they required were trucks of the Brill or Peckham type, which could be manufactured in England as well as in America, well and good; but to invite British firms to tender for a foreign article to the exclusion of the home-made, would warrant all the indignation expressed in the above resolutions.

Assessment Appeal.—At Salford Quarter Sessions the Middleton Electric Traction Co. successfully appealed against the rating of their undertaking, which had been assessed at £2,500 gross and £2,000 net. These figures were reduced to £1,000 and £550 respectively.

Fire Alarms: May-Oatway v. Sprinklers.—An interesting demonstration took place on Wednesday, before a number of visitors, at the offices of the *Glasgow Herald*, showing the comparative value of the May-Oatway fire alarm as compared with a system of sprinklers. Two of the May-Oatway detectors were fixed on the ceiling and put in electric connection with the Fire Brigade offices. Other detectors were exhibited on the walls of the room in order to allow the company present to inspect the details of the apparatus. The indicator consists of an iron bar fixed in a horizontal position, and stretched along this is a fine copper wire connected at the two ends only. On the temperature increasing the copper wire expands quicker than the iron, and therefore sags and allows the carbon block suspended at its centre to fall until it comes in contact with a pair of clips connected to the other pole of the battery. The circuit is thus completed, and the alarm given at the fire station, while at the same time the current passing through a piece of apparatus on the principle of the ordinary house-bell indicator drops a shutter indicating the room in which the outbreak has taken place. Two of these detectors were fixed to the ceiling of the room, which also carried a complete system of automatic sprinklers. Mr. Oatway briefly described the principles of his system, and announced that, arrangements having been made for the Fire Brigade to answer the call, the test would really be a competitive test between the automatic fire alarm and the sprinkler system. He stated that in order to ensure that the conditions should be absolutely fair to both, the test would be put into the hands of a committee, and the following gentlemen were requested to act in this capacity:—The firemasters of Glasgow, Edinburgh and Aberdeen, a representative of the Liverpool and London and Globe Insurance Co., and of the North British and Mercantile Insurance Co., Mr. Gourlay, Mr. Arthur Kay and Mr. W. A. Chamen, Glasgow Corporation electrical engineer. These gentlemen selected the place where the fire should be lit; this was almost directly under one of the sprinklers, but some distance from the two automatic alarms. Two large tanks of methylated spirits were then lit; 65 seconds after lighting the tanks the alarm bell was rung, and within 4 min. and 20 sec. of lighting, the Fire Brigade were in the room. A wait then took place, and the tanks had to be replenished and again lit. 16½ min. after the first lighting of the fire the sprinkler, which was immediately over the flame, began to work; the fire was then extinguished, and opportunity was given to those present to examine the details of the apparatus, which were explained by Mr. May and Mr. Oatway.

Lectures.—Prof. Schuster has been delivering a course of lectures on "Rays and Radio-activity" at the University of Manchester.

Royal Institution.—Among the names of new members elected at Monday's meeting we note that of Sir Oliver Lodge, LL.D., D.Sc., F.R.S.

Appointments Vacant.—The Gloucester T.C. is wanting a tramways manager, at £300 per annum, rising by £25 a year to £450; a lecturer in engineering is wanted for Rotherham Technical Institute, £120; mains assistant for Manchester, £150; junior assistants for Tyneside power station; the Sunderland Corporation wants a tramways general manager at £400 rising to £500.

Personal.—A smoking concert was held at the Collingwood Hotel, Newcastle-on-Tyne, on Saturday, October 31st, in honour of Mr. James Parmley Graham, who has just terminated his service of 15 years with J. H. Holmes & Co. as one of their commercial staff, to take up an important agency for the North of England for electrical and mechanical apparatus and materials. On behalf of the officials and staff, the secretary, Mr. Allen Crowe, presented Mr. Graham with a roll-top desk, and he was also the recipient of a handsome silver tea service from the firm. A very enjoyable evening was spent, and several testified as to the ability and character of Mr. Graham, who carries with him the best wishes of all members of the staff for his future success.

Mr. A. L. C. Fell, manager of the Sheffield Corporation Tramways, has been appointed chief officer of tramways to the London County Council, at a salary of £1,500 per annum. There were 53 applications for the position.

Mr. H. England, the tramway manager for the Sunderland Corporation, having been appointed manager for the Yorkshire Tramways Construction Syndicate, has resigned his position on Wearside. Our correspondent understands that the salary of the new appointment is £700, rising to £900, or £200 a year better than at Sunderland.

The Stockport T.C. has increased the salary of the manager of the electric tramways (Mr. McCormick) from £175 to £200 a year.

On October 29th, at the Reading Corporation tramways offices, Mr. Robert J. Fardell, chief clerk of the tramways department, was presented with a leather travelling bag, fitted with toilet accessories, from the officials and staff of the department on the occasion of his marriage. The general manager, Mr. W. Binns, made the presentation on behalf of the staff.

Plant for Sale.—The Ashton-under-Lyne Town Hall Committee wants offers for the purchase of a 70-B.H.P. Stockport gas engine, 40-KW. dynamo, E.P.S. battery, &c., of which particulars are given among our advertisements to-day.

Yorkshire College Engineering Society.—On Monday, October 26th, Mr. Welbury addressed a well-attended meeting of this Society at Leeds on "The Governing of Marine Engines."

Compulsory Purchase and the Land.—A question of considerable importance to electrical undertakers, those who are interested in electric traction, was decided in the case of the Goldsmiths' Co. *v.* The West Metropolitan Railway Co., which was heard in the Court of Appeal on October 30th. As our readers are aware, nearly every statute and provisional order for the execution of any public work of any magnitude prescribes a certain time within which the promoters are to acquire land by compulsory purchase. Thus it is generally provided that "the powers of the company for the compulsory purchase of lands for the purposes of this Act shall cease after the expiration of three years from the passing of this Act." In the case under review the defendant company had been empowered to take compulsorily part of the plaintiffs' land by an Act which received the Royal Assent on August 9th, 1899. On August 9th, 1902, they served a notice to treat in the manner usually prescribed. The plaintiffs objected, on the ground that the period of three years during which the right of compulsory purchase could be exercised, commenced to run on the day on which the Act received the Royal Assent, and that the period therefore expired at midnight on August 8th, 1902. It was argued on their behalf, that where a term was set running on a particular day, and was to run for a certain time, the first day was to be included. The defendants, on the other hand, argued that unless the day upon which the Act was passed were excluded from the calculation, they would not have the full period of three years. "Suppose," said the counsel who argued the case, "that the Act had said that the powers were to cease on the expiration of one day from the passing of the Act. It could not be said that the powers ceased on the expiration of the day on which the Act was passed." This view was adopted by the Court. In giving judgment, the Master of the Rolls said:—"The law was well stated by Baron Parke, in Russell *v.* Ledsam (14 M. & W., 582), where he said, 'The usual course in recent times has been to construe the day exclusively whenever anything was to be done in a certain time after a given event or date.' Here the Act was passed on August 9th, 1899, and therefore the three years began to run at the expiration of that day, the law, in such a case, taking no notice of a fraction of a day." In the result the notice to treat was declared to have been served in time. Although the company—to use a colloquial phrase—were running it rather fine, it is manifest that they were within their rights in postponing their notice to treat until the second anniversary of the day on which the Act was passed. The importance of the case to electric tramway and lighting companies lies in this, that it places an accurate limit upon the various periods prescribed in different Acts of Parliament, within which the right of compulsory purchase of the undertaking by the local authority may be exercised. In County of London electric lighting orders in favour of companies, it is the practice to provide that the period of 42 years (within which the power of purchase by the local authority may be exercised) shall run from one fixed date—namely, August 26th, 1889. We may, therefore, assert with confidence that the local authorities must exercise their right some time between that date and midnight of August 26th, 1931. A statement equally accurate might be made with regard to the compulsory purchase of tramway undertakings by local authorities at the end of some statutory period.

Single-Phase Motors for Traction.—The article on this subject, which we commence on p. 728, is a translation from a paper read by Dr. Finzi before the annual convention of the Associazione Elettrotecnica Italiana at Naples on October 11th and 12th. Unfortunately, these particulars reached us too late for insertion in the proper place.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Electric Ozone Syndicate, Ltd. (44,660).—Issue on October 9th, of £400 debentures, part of series created October 16th, 1901, to secure £6,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series, £5,600.

Brooker & Goss, Ltd., Electrical Engineers, Waltham Cross (76,425).—A debenture dated October 9th, 1903, to secure £500, charged on the company's undertaking and property, present and future, including unpaid capital, has been registered. Holder: F. Huth, 29, Clarendon Road, London.

Cross Electric, Engineering and Manufacturing Co., Ltd. (78,609).—A debenture dated October 20th, 1903, to secure £150, charged on the company's undertaking and property, present and future, including uncalled capital, has been registered. Holder: H. R. Smith, 106, Murray Street, Hoxton.

THE CENTRAL STATION ENGINEER.

An interesting ceremony took place at the Primrose Club, St. James's, on the 18th ult., when Mr. Jack Hawes, late assistant engineer to the Metropolitan Borough of Bermondsey electricity and dust destructor works, having been appointed chief assistant engineer to the firm of Messrs. Tyler & Duncan, was presented with a dressing case by Mr. A. E. Young, on behalf of the officials and staff of the above works, as an appreciation of his good services.

Mr. W. H. Alcock has resigned his position as engineer and foreman with Messrs. Collins, Kessler & Co., electrical and mechanical engineers, of Pietermaritzburg, &c., to take up an appointment with the electricity department of the City of Pietermaritzburg.

The Dublin Lighting Committee recommend the increase of the salary of Mr. Mark Ruddle, city electrical engineer, from £450 to £600, and that an increase of £50 per annum be granted to him for every £1,000 profit made by the undertaking after payment of working expenses, of the interest on the loan, and of the annual repayment of principal, up to a maximum salary of £1,000.

Honley U.D.C. has appointed Mr. C. F. Coldwell as electrical engineer.

ELECTRICITY SUPPLY ACCOUNTS.

Edinburgh Municipal Electricity Department.

The Edinburgh electrical department continues the steady progress which has characterised its operations since the commencement of supply in 1895.

The department benefits by a considerable street lighting and a growing motor load, and that it is successful financially will be gathered from the fact that a gross profit of 7·8 per cent. on the capital expended has been earned during the past year.

The output during the past three years is shown by the following figures:—

Year.	Priv. lighting.	Motor power.	Arc lamps.	Total sold.
1901 ...	4,484,572	996,850	1,226,514	6,707,936
1902 ...	5,123,133	1,325,481	1,310,609	7,759,223
1903 ...	6,019,815	1,695,153	1,280,840	8,995,808

The prices charged are: For private lighting, 3¾d. per B.T.U., flat rate, with discount; power, 1¼d. per unit; public arcs, £11 per annum. Mr. F. A. Newington is the resident electrical engineer.

General Statement.

For year ending May 15th—	1903.	1902.
Total capital expended	£800,710	£765,612
Number of units sold	8,995,808	7,759,223
Equivalent No. of 8-c.p. lamps. (Ltg. only)	419,806	312,098
Number of public arc lamps	995	846
Horse-power of motors connected	4,078 h.p.	2,084 h.p.
Maximum load in kw.	7,174 kw.	6,007 kw.
Revenue account—		
Gross revenue	£103,365	£90,960
„ expenditure	£41,120	£37,923
„ profit	£62,244	£53,037
Average price obtained per unit—		
Private lighting...	2·86d.	2·98d.
Public lighting	2·16d.	2·16d.

Revenue Account.

	1903. Gross.	Per unit.
Sale of energy	£103,072	2·75d.
Meter rents	62	·00d.
Property rents, &c.	231	·00d.
Gross revenue	£103,365	2·75d.

Costs of Production.

	1903. Gross.	Per unit.
Coal	£10,561	·28d.
Oil, waste, water and engine-room stores ...	1,631	·05d.
Salaries and wages incurred in generation and distribution	5,378	·15d.
Repairs and maintenance of machinery, buildings and plant	7,263	·19d.
Works and distribution costs	£24,833	·67d.
Repairs, maintenance and attendance public lamps	4,069	·11d.
Rents, rates and taxes	5,964	·16d.
Management expenses, salaries of engineer and clerical staff	2,820	·07d.
General establishment charges, including stationery, printing, law, insurance	3,434	·09d.
Total works costs	£41,120	1·10d.

Profit Statement.

To interest on loans	£20,161
To sinking fund	27,431
To income-tax	120
To balance on year's working carried forward ...	14,532
Gross profit	£62,244

On the year's work the department earned a gross profit of £62,244; financial charges absorb some £48,000 of that amount, and the balance, amounting to £14,532, is carried forward to next year's account. The balance of £7,606 from the last account is carried to the reserve fund, which now amounts to £27,435.

Aberdeen Municipal Electricity Department.

We give herewith an analysis of the returns of the Aberdeen Electricity Department for the year ending July 31st, 1903. During the past year the whole of the tramways have been electrically equipped, and motive power supply has largely increased; these developments being instrumental in increasing the output from 1,546,569 to 2,577,308 units. Both public and private lighting are on the increase, and with the new works in going order, and a load factor of 17 per cent., Mr. Bell, the borough electrical engineer, may be congratulated on having placed the department in an excellent position. The works costs are substantially lower than last year, and would be considerably lower still, but for the inclusion of special charges due to heavy mains expenditure.

The charges are: For private lighting, 6d. for the first hour, and 2½d. per B.T.U. after; power, 3d. and 1d. per B.T.U., both on the maximum demand system.

General Statement.

For year ending July 31st—	1903.	1902.
Total capital expended	£194,079	£167,173
Number of units sold—		
Private consumers	1,274,790	979,016
Traction	1,085,306	381,495
Public lamps	217,212	186,058
Total number of units sold ...	2,577,308	1,546,569
Equivalent No. of 8-c.p. lamps	126,327	101,473
Number of public arc lamps	281	235
h.p. of motors connected	1,160 h.p.	838 h.p.
Maximum load in kw.	1,557 kw.	1,205 kw.
Revenue account—		
Gross revenue	£29,875	£22,916
„ expenditure	£13,963	£9,933
„ profit	£15,912	£12,983
Average price per unit—		
Private supply	3·69d.	4·19d.

Revenue Account.

	1903. Gross.	Per unit.
By sale of energy (less abatements)	£28,916	2·69d.
Motor hire, harbour lamps, &c.	959	·09d.
Gross revenue	£29,875	2·78d.

Works Costs.

	1903. Gross.	Per unit.
Coal	£5,929	·55d.
Oil, waste, water and engine room stores ...	665	·06d.
*Wages incurred in generation and distribution	1,538	·14d.
Repairs and maintenance of machinery, buildings and plant	2,399	·22d.
Works and distribution costs	£10,531	·97d.
Rent, rates and taxes	1,748	·16d.
Management expenses, including salaries of engineer and clerical staff, general establishment charges, printing, stationery, bad debts, special services, &c.	1,684	·16d.
Total works costs ...	£13,963	1·29d.

* Amount of £367 received from Tramways Department for services of engineering staff, deducted.

Profit Statement.

	1903.
Interest on loans	£5,674
Sinking fund	3,471
Depreciation	5,066
Surplus	1,701
Gross profit	£15,912

The available balance, amounting to £15,912, was allocated as shown above. The amount set aside for depreciation is arrived at as follows:—

Buildings	at 1 per cent.	£316
Machinery	at 5 ,,	2,834
Accumulators	at 5 ,,	384
Mains and services... ...	at 1½ ,,	949
Electrical instruments ...	at 2½ ,,	81
Meters	at 5 ,,	502
		£5,066

and the total amount thus written off is £18,839. The department has also set aside a reserve fund amounting to £9,558.

York Electricity Accounts.

We have received the following letter in reference to the analysis of the York electricity accounts in our issue of October 23rd:—

"Allow me to draw your attention to the above department's accounts, which appeared in your issue of last week.

"Here you state the total deficiency on the three years' working to be £1,248 8s. 10d.

"This is not so—the balance in hand at March 31st, 1902, was £448 11s. 5d.—the deficiency on the year's working to March 31st, 1903, being £799 17s. 5d., thus leaving a total deficiency on the three years' working of £351 6s.

"Trusting that you will kindly rectify this error in your next issue.

"C. A. Midgley.

"York, *October 29th*, 1903."

[We regret that the above error should have occurred, but would point out that it is solely due to the manner in which the returns were made out. In this instance there were not only great discrepancies between the 1902 returns forwarded last year and this, but also no mention whatever occurs of interest and sinking fund. In view of the above letter, the figures for the 1902-3 profit statement should read:—Interest and sinking fund, £3,021, debit balance on year's working, £800; and total debit balance as stated by our correspondent.—Eds. Elec. Rev.]

CITY NOTES.

Western Telegraph Co., Ltd.

Sir John Wolfe Barry, K.C.B. (chairman), presided on Wednesday at River Plate House, E.C., over the sixtieth ordinary general meeting of the above company.

In moving the adoption of the report, the Chairman said the message fund account for the half-year under review amounted to £213,000, and for the corresponding half-year ending June 30th, 1902, the fund amounted to £196,500, showing a satisfactory increase of £16,500. The larger portion of this increase was attributable to increased trade in the River Plate. The interest on deposits, rents and transfer fees, was practically the same as in the corresponding period. The dividends on investments in other telegraphic companies (£14,790) showed a slight decrease of £800. Turning to the expenses, those in London showed a small decrease of £41. At the stations there was a net increase of £1,737. Of this increase, £556 was owing to travelling expenses. Rent and house allowance, and other items, were increased £513, principally due to their having had to grant an allowance to the Rio de Janeiro staff pending the completion of their new and improved quarters. When they came to repairs of cables and expenses to ships, they found that in the previous half-year these expenses were comparatively small, and thus for the past half-year there was an increase of £14,589. Of this increase, nearly £11,000 was for new cable which had been used in repairs, and the depreciation had been written off cable in stock. They had lately bought and sent out a small steamer called the *Cormorant*, which had been usefully employed since her arrival in South America in executing repairs. They had invested nearly £50,000 during the year on account of reserve fund. The difference between the cost of the investments they held on account of the reserve fund and the present market price, represented an average depreciation of 5¾ per cent. That the shareholders would readily realise was due to the abnormal depression of all securities, even of the most gilt-edged type. They had, during the last three or four years, made considerable profits when the sale of investments had been necessary, and shareholders would recollect that the interest was always carried to the credit of the reserve fund. The broad result of the half-year's working was, that after providing £13,500 for debenture stock and debenture interest and sinking fund, and £3,239 for income-tax, there remained a balance of £117,500. To this was added £5,331 brought forward, making a total of £122,811. A quarterly interim dividend, amounting to £31,000, had been paid, and £35,000 transferred to the general reserve fund, and £2,000 to the maintenance ships reserve fund. The directors recommended the declaration of a final dividend of 3s. per share, making, with the interim dividends, 6 per cent. for the year, and also the payment of a bonus of 2s. per share, both free of income-tax, which, together, would amount to £51,982, leaving a balance of £2,639 to be carried forward. The revenue to date for the current half-year was not quite so satisfactory as that for the corresponding period of 1902. The decrease was not serious, but there was no sign of increase, and the diminution was due to the continual falling off of the receipts from the inter-South American traffic. They had to compete for that with the Government, and, being in competition, they must take the matter as they found it; and, although they did the best they could, they found that the traffic did not show any signs of increase. He might say, on the other side, that thus far the expense of repairs to cables had been below the average. Their revenue, of course, depended on the trade of the countries they served, and also to a considerable extent on the amount of repairs to cables. Both of those matters were outside the control of the directors of a public company. On the whole, he thought he might congratulate the shareholders on what he might call a satisfactory but uneventful report, and he thought it was a source of gratification that there were no matters calling for special mention.

Sir J. Denison Pender seconded the resolution.

A shareholder called attention to the fact that the amount credited in the balance-sheet for interest on investments showed a considerable difference as compared with the income which ought to be received from that source.

The Chairman explained that no investments were in default, and the difference was due to the fact that a number of securities were bought just before the date of the account, and no interest had been received on them at that date.

Other shareholders referred to a statement which had appeared in the Press to the effect that Marconi messages were affected by the sun's light, and also to the recent magnetic storm.

The Chairman, in reply, said he could add nothing to what he had already said as to wireless telegraphy. They said that within certain limits it was a useful invention, but he saw no more reason to apprehend serious competition with cable companies now than he did when he first referred to the matter two or three years ago. With regard to the magnetic storm, it was a storm of unusual character, not only in its severity, but also in respect to the large area it covered. It was, however, only one of those examples of a particularly severe storm of a nature of which they had had previous experience, and to that extent it was extremely interesting from a scientific point of view. It had passed away, and business was being conducted as usual. So far as they knew, the cables were left in just the same condition as they were before the storm.

The report was adopted.

Cape Electric Tramways, Ltd.

The report for the year ended June 30th, 1903, to be presented at the meeting on 18th inst., states that the profit and loss account, after making provision for debenture interest and redemption of debentures, shows a net credit balance of £66,372, which, added to the balance of £14,540 brought forward from last year, makes a gross total profit of £80,912. Dividends amounting to 15 per cent. have been paid. The directors have also placed to the credit of reserve fund the sum of £8,000. These several sums aggregate a gross total of £80,000, and leave a balance of profit of £912 to be carried forward. The result of the year's transactions shows that the traffic on the tramway systems in South Africa has maintained itself at the high level of previous years; on the other hand, expenditure and maintenance have, owing to a variety of causes, shown a large increase over 1902, reducing the profit by about £15,000. Improvements and additions to the car-shed and power house, with additional machinery in Cape Town, have at last been completed. The total cost of these new works has amounted to £84,919, which has exceeded the original estimate by £30,000; this increased expendi-

ture is mainly due to the enhanced prices for all labour and material which obtained during the unsettled period of the war and immediately following the conclusion of peace. The reserve fund, which has now reached a total of £137,000, has met this expenditure, and consequently it has not been found necessary to raise further capital. The Port Elizabeth system also has not escaped increased expenditure, owing to the general rises in values and scarcity of labour before referred to, although these causes were not felt so acutely as in Cape Town. On January 1st, 1903, the directors leased from the Cape Town Consolidated Tramways and Land Co. their Camps Bay tramline, to work the same for a period of three years, with an option of purchase at the expiration of the lease. The first six months' working by this company has shown a loss of £3,284, caused by the exceptionally bad weather prevalent in Cape Town during the greater part of this period. The directors anticipate, however, a satisfactory improvement on these figures as development progresses on the townships projected on the estates of the Cape Town Consolidated Tramways and Land Co., at Camps Bay and Oranjezicht.

Rosario Electric Co.

Mr. W. T. Western, presiding at this company's meeting on Monday, said that the concern they had taken over was one of some years' standing, but the station had been put down in the wrong place, and for the past 14 months they had been busy putting down a new station and installing new plant. In July the new machinery was ready to make trial runs, and these proving satisfactory, it was taken over from the contractors. They then had to commence to gradually transfer their customers from the old high tension to the new continuous current supply. The re-wiring would be spread over the next two or three years. The dividend was equivalent to 3 per cent. on the capital. The chairman mentioned that both stations would have to be run for a time, and the full benefit of the new customers would not be derived for the whole of the current year. The shareholders must, therefore, not be disappointed if there should not be a better result in net profit than was shown on last year's working.

British Columbia Electric Railway Co.

Mr. G. P. Norton, presiding at this company's meeting on 30th ult., said that during the year there had been considerable development in all directions. After they obtained advantage of partial utilisation of the water-power installation in December, progress would be even more rapid, and the undertaking would, in time, become one of considerable magnitude, involving additional capital outlay. Since the closing of the financial year, the net earnings for the three months ended September 30th showed an increase upon the corresponding period of last year of £3,647. He directed attention to the announcement in the report respecting the £45,000 of Vancouver Power bonds which were to be offered at an early date. The board thought that those debentures should be first offered to the existing stockholders, and this would probably be done during December.

Mr. E. L. Evan-Thomas seconded the adoption of the report, and it was carried.

The retiring directors and auditors were re-elected.

A resolution was subsequently passed altering one of the articles so as to admit of directors of this company taking seats on the board of the Vancouver Power Co.

Monte Video Telephone Co.

Mr. F. W. Jones, presiding at the meeting of this company, held at Winchester House on 29th ult., referred to the continued progress of the company and to the satisfactory outlook. The telephone system of La Hispano Uruguaya had been acquired; it had 14 small exchanges and 300 subscribers. The system was of great assistance to the Monte Video business. The chairman pointed out that the current year's expenditure would be met without issuing new capital, but later, with continued extension of the system, a debenture issue would have to be made. He formally moved the adoption of the report, and it was carried unanimously.

British Aluminium Co.

The resolutions printed in our last issue for reducing the capital came before the meeting held on Wednesday at Winchester House. Mr. J. D. Bonner presided, and he said that the amount by which they proposed to write down the capital was the minimum amount that could have been expected, after the result of the investigation of Mr. Harmood Banner in 1902. Some shareholders considered that the proposals were hardly sufficiently drastic. The business of the company had considerably improved during the current year, but it was difficult to estimate the amount of profit. They were rapidly depleting their old stocks of aluminium. Trouble had been experienced with the Foyers backwater, but the board hoped that the new furnaces would be started by the end of this year.

The resolutions were adopted.

West India and Panama Telegraph Co.—The directors recommend a dividend of 8s. per share on account of arrears of dividend on the first preference shares.

STOCKS AND SHARES.

Wednesday Evening.

Fears of a 5 per cent. Bank Rate acted as a depressing influence when the Stock Exchange reassembled for work after its Monday recess, but these subsequently wore off to some extent owing to the abundance of money available for contango purposes in the Consol market. Whether the minimum will be raised on Thursday it is impossible to say in these Wednesday notes, but if a 5 per cent. rate should come into force, business in securities known as investment would be sadly hampered, and the electrical departments must be prepared to suffer with the rest. At the moment, prices of the stocks and shares with which we are concerned in this column, keep their levels with praiseworthy tenacity, and in spite of pressure to sell in a few instances, the investor continues to quietly take all the good shares which come on offer.

New issues are as coy as ever of making an appearance, but the City of Cape Town Corporation, in offering a million pounds 4 per cent. stock at 97, includes among the assets of the municipality an electric light installation that is valued at £200,000. Supply of electrical current figures among the items of gross receipts for 1902 at £46,351, and the statistics will be noted with interest by those who take concern in the prosperity of the Cape, even while they will probably confess that the issue holds out no particular attraction except as a lock-up investment stock. Cape Electric Tramways shares, by the way, are a trifle easier at 2⅛, and sellers at that. The company's report is not relished, it being considered by the market that a less dividend should be paid and that the carry-forward ought not to be reduced by £13,600. After last year's distribution of 16 per cent., the coming payment of only 1 per cent. less will be pleasant enough for proprietors, but to drastically cut down the carry-forward is regarded as finance of doubtful prudence. British Electric Traction Ordinary are ¼ down, the Preference and Debenture showing no change. Anglo-Argentine Trams have advanced ½ upon the flourishing condition of the republic, and the renewed attention directed to its undertakings. Brisbane Electric Preference have nominally fallen ¼ to 4, but 2s. 6d. of this is represented by the dividend deducted last account day. British Columbia Electric Railway Preferred at 94½ is up a point. Colombo Electric 5 per cent. Debenture stock at 101½ is now *ex* interest.

No evil effects have befallen the telegraph market by reason of the extraordinary electrical disturbances of a few days ago. The few changes which there are to chronicle mostly have the dividend deductions as their cause. Both the Cuba Submarine shares have been marked *ex*, the Ordinary, of course, losing their bonus as well. There are three others, none of which has recovered the distribution so far, as is the case with Oriental Telephone Ordinary, where, however, the dividend only amounts to 7d. and a fraction. National Telephone Deferred has spurted two points, and the third Preference are ⅛ up, the other issues of the company remaining without change. The Globe Telegraph and Trust twins have risen the amount of their dividend, viz., 2s. and 3s. in the case of the Ordinary and Preference shares respectively.

Almost the only variation in the electric lighting list is furnished by Blackheath and Greenwich Preference shares, which do not come into the Stock Exchange *Official List* yet. The price has fallen a shade to 1⅛ upon the appearance of one or two sellers. New Metropolitan Preference are now £4 paid, and the premium continues to be about 5s. per share. Considerable curiosity is expressed as to what may be the result of the five changes on the Borough Council. Edmundson's Preference have been made *ex* their dividend of 3s., and the price is put down ¼ on it. A fair demand for Urban Electric Supply must be noted; the Preference shares appear to be as sound a 5 per cent. investment of their kind as can be found throughout the list.

Metropolitan Railway Consolidated stock is in demand upon electrification hopes, and the price is good at 82, the latter figure representing the rise on the week. A month or so back a few suggestions were made in this column as to the attractiveness that Metropolitans hold out to the investor who can bide his time, and the rise, in our opinion, is only just beginning. It may be held back by sympathetic dulness with the rest of the Home Railway market, but a gradual appreciation of the price can be regarded as simply a matter of time. Districts lag behind; but a fractional advance has been secured at 31½. The electrical railway stocks exhibit no changes. City and South London receipts show a decrease for last week of £485, and the Central London figures are £409 on the wrong side; but since comparison is made with a period when London was exceptionally full last year, the statistics pass as fairly satisfactory.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations Oct. 28th.	Closing Quotations Nov. 3rd.	Business done week ended Nov. 3rd, 1903. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	99 —103	99 —103	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	2¼— 3½	2¼— 3½	..	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	70 — 80	70 — 80	..	..
788,840	Anglo-American Telegraph	Stock	3½%	6½	6 6/8	46 — 49	46 — 49	47½	47½
3,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	90 — 92	91 — 93	93	91½
3,105,580	Do. do. do. Deferred	Stock	5s. %	3s.	1/-	7½— 7¾	7½— 7¾	7 7/16	7 7/16
44,000	Chili Telephone, Nos. 1 to 44,000	5	5 %	5 %	6 %	4½— 5½	4½— 5½	..	..
13,333,300$	Commercial Cable	$100	8 %	8 %	8 %	145 —155	145 —155	..	..
1,841,300	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	90 — 93	90 — 93	90¾	90¼
16,600	Cuba Telegraph	10	4½%	4 %	6½%	7½— 8½	7 — 8	7 7/16	..
6,000	Do. 10 % Pref.	10	..	..	..	16⅝— 17½	16 — 17 xd	..	..
12,981	Direct Spanish Telegraph	5	4 %	4 %	4 %	2½— 3½	2½— 3½	..	..
6,000	Do. do. 10 % Cum. Pref.	5	..	..	..	7 — 8	7 — 8	..	..
30,000	Do. do. 4½ % Debs.	50	..	..	..	98 —102 %	98 —102 %	..	..
60,710£	Direct United States Cable	20	3½%	3½%	3½%	10½— 10¾	10½— 10¾	..	..
67,800	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —102	99 —102	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	123 —128	123 —128	125½	123⅛
1,955,565	Do. 5½ % Pref. Stock	100	..	..	..	86 — 89	86 — 89	86	..
1,534,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	106 —109	104 —107 xd	104½	..
800,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	11½— 12	11½— 12	11 13/16	..
320,000£	Do. 4 % Deb. Stock	Stock	..	..	..	104 —107	104 —107	..	..
300,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 3,000, red. 1909	100	..	..	..	99 —102	99 —102	..	..
200,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	100 —103 %	98 —101% xd	100½	..
150,227	Globe Telegraph and Trust	10	5½%	5½%	..	8⅜— 9½	8⅜— 9½ xd	8⅝	8⅜
180,042	Do. do. 6 % Pref.	10	..	..	..	12⅜— 13½	12⅜— 13½ xd	12½	..
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	15 %	12½%	22½— 23½	22½— 23½	..	..
62,500£	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —102	99 —102	99⅜	..
17,000	Indo-European Telegraph	25	10 %	10 %	10%	37 — 40	36 — 39 xd	..	..
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	..	..	..	98 —102	98 —102	..	..
1,988,333	National Telephone, Pref. Stock	100	5 %	5 %	6 %	99 —101	99 —101	100⅜	99½
1,966,667	Do. do. Def. Stock	100	..	..	4½%	72 — 74	74 — 76	75½	74½
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	..	..
2,250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	4⅜— 5½	5 — 5¼	..	..
600,000£	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	92 — 94	93 — 95	93½	..
600,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	102 —104	102 —104	103½	103
179,313	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6 %	6 %	⅞— 1	⅞— 1 xd	..	..
50,000	Do. do. do. 6 % Cum. Pref.	1	..	..	..	.. — ..	1 — 1⅛	..	..
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	97 —100	97 —100	..	..
11,889	Reuter's	8	5 %	5 %	..	6½— 7½	6½— 7½	..	..
8,808	Submarine Cables Trust	Cert.	..	..	..	116 —121	115 —120	..	..
58,000	United River Plate Telephone	5	7 %	7 %	7 %	5½— 6	5½— 6	5⅝	5 5/8
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	4½— 5½	4½— 5½	..	..
179,947£	Do. do. 5 % Debs.	Stock	..	..	..	104 —107	104 —107	..	..
15,609	West African Telegraph, Shares	10	..	..	2 %	5 — 6	5 — 6	..	..
150,000£	West Coast of America, 4% Debs., 1 to 1,500 guar. by Bras. Sub. Tel.	100	..	..	..	95 — 98	95 — 98	..	..
267,280	Western Telegraph, Ltd., Nos. 1 to 207,280	10	7 %	7 %	7 %	12 — 12½	12 — 12½	12¼	..
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	100 —103	100 —103	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	98 —101	98 —101	..	..
88,321	West India and Panama Telegraph	10	1%	..	..	⅜— ½	⅜— ½	..	..
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	6 — 6½	6 — 6½	6¼	..
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	3½— 4½	3½— 4½	..	..
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	..	..	..	101 —104	101 —104	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

30,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	4½— 5½	4½— 5½	..	..
800,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	..	..	..	85 — 89	85 — 89	..	..
100,000	British Electric Traction	10	9 %	9 %	8 %	11½— 12½	11½— 12	12	11⅞
100,000	Do. do. 6 % Cum. Pref.	10	..	..	..	11 — 11½	11 — 11½	11⅜	11
600,000£	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	120 —128	120 —129	122½	121⅞
100,000	British Insulated and Helsby Cables	5	15 %	10 %	10 %	6 — 6¼	6¼— 6⅜	..	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5¼— 5⅜	5¼— 5⅜	..	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red...	100	..	..	..	102 —105	102 —105	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	8 %	Nil	..	2 — 2⅛	2 — 2⅛	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	6 %	6 %	..	14/6 to 15/6	14/6 to 15/6	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	5 %	Nil	Nil	1⅜— 1½	1⅜— 1½	..	..
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	3 %	6 %	1⅞— 1⅞	1⅞— 1⅞	1 7/8	..
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	97 —100	97 —100	..	..
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	85 — 90	85 — 90	..	..
35,000	Callender's Cable Construction shares	5	15 %	20 %	15 %	11½— 12½	11 — 12 xd	11½	..
40,000	Do. do. 5 % Cum. Pref.	5	..	..	..	5¼— 5⅜	5¼— 5⅜	..	..
90,000£	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	106 —110	106 —110	106⅜	..
1,860,014	Central London Railway, Ord. Stock	Stock	..	4 %	4 %	95 — 98	95 — 98	97	..
494,098	Do. do. 4 % Pref. Stock	Stock	..	4 %	4 %	99 —102	99 —102	..	..
494,998	Do. do. Def. do.	Stock	..	4 %	4 %	99 —102	99 —102	..	..
1,330,000	City and South London Railway	Stock	1½%	2 %	3½%	51 — 53	51 — 53	52½	52
85,000	Crompton & Co., Nos. 1 to 85,000	3	8 %	7½%	5 %	2 — 2½	1⅞— 2¼	..	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	100 —104	100 —104	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261	5	2½%	Nil	..	0 — ¼	0 — ¼	..	..
17,189	Do. do. "A" shares, 01—017,189	5	2½%	Nil	..	1½— 2⅜	1½— 2⅜	..	..
344,023£	Do. do. 4 % Deb. Stock Red.	100	..	..	..	72 — 77	72 — 77	..	..
100,000£	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	..	..	..	76 — 81	76 — 81	..	..
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	1½— 1⅝	1½— 1⅝	..	..
31,890	Do. do. 7 % Cum. Pref., 1 to 31,890	2	..	..	..	2½— 3	2½— 3	..	..
82,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	97 —100	97 —100	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	9½— 10½	9½— 10½	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	96 — 99	96 — 99	..	..
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	20 %	20 %	14 — 15	14 - 15	14¾	..
35,000	Do. do. 4½ % Pref.	5	4½%	..	..	5 — 5¼	5 — 5¼	5 1/8	..
48,050	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	108 —112	108 —112	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	10 %	18½ - 19½	18½— 19½	18⅞	18 1/2
800,000£	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	100 —103	100 —103	..	..
37,500	†Liverpool Overhead Railway, Ord.	10	3½%	1½%	1½%	4⅜— 4½	4⅜— 4½	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	10½ - 10¾	10½— 10¾	..	..
37,250	Telegraph Construction and Maintenance	12	17½%	20 %	20 %	34 — 37	34 — 37	..	..
150,000£	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	100 —103	100 —103	..	..
540,000£	Waterloo & City Railway, Ord. Stock	100	3 %	3 %	3½%	93 — 96	93— 96	..	..

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

Bank rate of discount 4 per cent. (September 3rd, 1903).

SHARE LIST OF ELECTRICAL COMPANIES (*continued*).—ELECTRICITY SUPPLY COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations Oct. 28th.	Closing Quotations Nov. 3rd.	Business done week ended Nov. 3rd, 1903. Highest.	Lowest.
		‡							
100,000	Blackheath and Greenwich Dist. Electric Light, Ord...	1	..	..	..	⅝— ⅞	⅝— ⅞	..	..
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs. ..	100	..	..	..	116 —119	116 —119	..	..
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	5	6 %	8 %	8 %	10½— 10⅝	10½— 10⅝	..	..
20,000	Do. do. 7 % Cum. Pref. ..	5	..	..	..	10 — 10½	10 — 10½	..	..
50,000	Charing Cross and Strand Electricity Supply	5	9 %	10 %	10 %	9 — 9⅛	9 — 9⅛	9⅛	..
70,000	Do. do. do. 4½% Cum. Pref. ..	5	..	..	..	5¼— 5⅜	5¼— 5⅜	..	..
40,000	Do. do. "City Undertaking" 4½% Cum. Pref. ..	5	..	..	..	4½— 5	4½— 5	..	..
250,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	104 —106	104 —106	..	..
44,486	*Chelsea Electricity Supply, Ord.	5	5½%	4 %	4½%	5¼— 6	5¼— 6	..	..
150,000‡	Do. do. % Deb. Stock Red.	Stock	..	..	..	108 —111	108 —111	..	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595	10	0 %	5 %	5 %	9⅞ — 10¼	9⅞— 10¼	10⅜	10⅛
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	..	..	13 — 14	13 — 14	..	..
400,000‡	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid	..	..	..	..	122 —127	122 —127	..	..
800,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	..	..	..	102 —105	102 —105	..	..
40,000	County of London & Brush Prov. Electric Lighting, Ord. 1—40,000..	10	4 %	4 %	4 %	7⅞— 8⅛	7⅞— 8⅛	..	..
20,000	Do. do. do. 6 % Pref., 40,001—60,000..	10	..	..	..	11¾— 12⅛	11¾— 12⅛	..	..
400,000‡	Do. do. 4½% Deb. Stock	..	..	..	..	107 —110	107 —110	..	..
250,000	Do. do 4½% 2nd Deb. Stock	Stock	..	..	..	100 —103	99 —102 xd	100⅜	..
50,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	7 %	6½— 6⅝	6½— 6⅝	6⅝	6 3/16
30,000	Do. do. 6 % Cum. Pref.	..	..	..	..	6¼— 6⅜	6 — 6⅛xd	6¼	..
140,000	Do. do. 4½% 1st Mort. Deb. Stock ..	100	..	..	..	105 —108	105 —108	..	..
21,000	Kensington and Knightsbridge Electric, Ord.	5	12 %	10 %	10 %	10½— 11⅛	10½— 11⅛	..	..
90,000	Do. do. do. 4 % Debenture Stock ..	Stock	..	..	..	101 —104	101 —104	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	3	..	..	..	1⅞— 2⅛	1⅞— 2⅛	..	..
49,840	Do. do. do. 6 % Pref.	5	..	..	..	5¼— 5⅜	5¼— 5⅜	5 5/16	..
250,000‡	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	..	..	..	100 —102	100 —102	..	..
100,000	Metropolitan Electric Supply, 1 to 100,000	10	6 %	6¼%	7½%	17¾— 18½	17¼— 18⅝	17⅞	..
71,106	Do. do. 4½% Cum. Pref. 1—71,106, £3 paid ..	5	..	..	..	3⅛— 3⅜	4⅛— 4⅜	..	..
220,000‡	Do. do. 4½% 1st Mort. Deb. Stock	..	..	..	..	110 —114	110 —114	..	..
250,000‡	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	..	..	97 —100	97 —100	97	..
10,853	Notting Hill Electric Lighting	10	7 %	6 %	6 %	12½— 13½	12¼— 13½	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14½— 15½	14½— 15½	14½	..
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	5	..	..	..	8 — 9	8 — 9	..	..
150,000‡	Do. do. do. 3½% Deb. Stock Red ..	100	..	..	..	97 —100	97 —100	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	..	..	2½%	8 — 8½	8 — 8½	..	..
65,000	South London Electricity Supply, Ord.	5	..	..	1¼%	3¾— 4	3¾— 4	3⅞	..
80,000	Urban Electric Supply, Ord.	5	..	..	..	4½— 5⅛	4½— 5⅛	5	..
80,000	Do. do. 5 % Cum. Pref.	5	..	..	..	4½— 5	4½— 5	..	..
110,000	Westminster Electric Supply, Ord.	5	10½%	10½%	12 %	12 — 13	12 — 13	12⅜	12⅜
28,141	Do. do. 5 % Cum. Pref.	5	..	..	..	6 — 6½	6 — 6½	6 7/16	..

*Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, November 4th.

CHEMICALS, &c.		Latest Price.	Week's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
a ,, Oxalic	per cwt.	32/-	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	..
a ,, ,, ...	per ton	£30	..
a Bleaching powder	per ton	£4 10	..
a Bisulphide of Carbon	per ton	£15	..
a Borax	per ton	£13	..
a Benzole (90 %)	per gal.	7/-	..
a ,, (50/90 %)	per gal.	5/6	..
a Copper Sulphate	per ton	£20	..
a Lead, Nitrate	per ton	£24	..
a ,, White Sugar	per ton	£31	..
a ,, Peroxide	per ton	£27 10	..
a Methylated Spirit	per gal.	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	..
a Potash, Bichromate, in casks ..	per lb.	3d.	..
a ,, Caustic (75/80%)	per ton	£24	..
a ,, Bisulphate	per ton	£35	..
a Shellac	per cwt.	210/-	10/- inc.
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 10	..
a ,, Recovered	per ton	£5 10	..
a ,, Lump	per ton	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	..
a ,, Crystals	per ton	£3	..
a ,, Bichromate, casks	per lb.	2¼d.	..

METALS, &c.			
b Aluminium Ingots, in ton lots ..	per ton	£130	..
b ,, Wire, in ton lots ..	per ton	£168	..
b ,, Sheet, in ton lots ..	per ton	£166	..
p Babbitt's metal ingots	per ton	£43 to £130	..
c Brass (rolled metal 2' to 12') basis	per lb.	7d.	..
c ,, Tube (brazed)	per lb.	9d.	..
c ,, ,, (solid drawn) ..	per lb.	7⅞d.	..
c ,, Wire, basis	per lb.	7½d.	..
c Copper Tubes (brazed)	per lb.	9¼d.	..
c ,, ,, (solid drawn) ..	per lb.	9⅜d.	..
g Copper Bars (best selected ..	per ton	£73	..

METALS, &c. (*continued*).		Latest Price.	Week's Inc. or Dec.
g Copper Sheet	per ton	£73	..
g ,, Rod	per ton	£73	..
c ,, (Electrolytic) Bars ..	per ton	£67	..
c ,, ,, Sheets ..	per ton	£77	..
c ,, ,, Rod ..	per ton	£69	..
c ,, ,, H.C. Wire	per lb.	8¼d.	..
f Ebonite Rod	per lb.	3/3	..
f ,, Sheet	per lb.	3/-	..
n German Silver Wire	per lb.	1/6	..
h Gutta-percha fine	per lb.	3/-	..
h India-rubber, Para fine	per lb.	4/- to 4/2	3d. dec.
i Iron, Charcoal Sheets	per ton	£18	..
i ,, Pig (Cleveland warrants)	per ton	43/2	6d. inc.
i ,, Forgings, according to size	per ton	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	..
i ,, Wire, galvanised No. 8 ..	per ton	£9 15	..
g Lead, English Ingot	per ton	£11 10 to £11 12 6	..
g ,, ,, Sheet	per ton	£13	..
m Manganin Wire No. 28	per lb.	8/-	..
g Mercury	per bot.	£8 7 6	..
d Mica (in original cases) small ..	per lb.	4d. to 1/6	..
d ,, ,, ,, medium	per lb.	2/6 to 3/9	..
d ,, ,, ,, large ..	per lb.	4/- to 7/9	..
p Phosphor Bronze, plain castings	per lb.	1/- to 1/2¼	..
p ,, rolled bars & rods	per lb.	1/- to 1/3	..
p ,, ,, strip & sheet	per lb.	From 1/1	..
o Platinum	per oz.	£4	..
p Silicium Bronze Wire	per lb.	9d. to 11d.	..
i Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
i ,, ,, in bars		£15 to £40	..
g Tin, Block	per ton	£122 to £123	10/- dec.
g ,, Foil	per lb.	1/6	..
n ,, Wire, Nos. 1 to 16	per lb.	1/7	½d. inc.
p White Anti-friction Metals— "White Ant" brand ..	per ton	£42 to £62	..
f Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	8d.	..
j ,, 6 lea. Flax	per lb.	5⅝d.	..
j ,, 3 ply 10 lbs. Russian ..	per lb.	4½d.	..
j ,, 10 lbs. Russian, single ..	per lb.	4½d.	..
j ,, 180 lbs. Jute rove ..	per ton	£11	..
k Zinc, Sh't (Vieille Montagne bnd.)	per ton	£23 15	..

Quotations supplied by Messrs.:—*a* G. Boor & Co.; *b* The British Aluminium Co., Ltd.; *c* Thos. Bolton & Sons., Ltd.; *d* F. Wiggins & Sons.; *e* Frederick Smith & Co.; *f* India-Rubber, G.P. and Teleg. Works Co., Ltd.; *g* James & Shakspeare; *h* Edward Till & Co.; *i* Bolling & Lowe; *j* Walter H. Hindley and Co., Ltd.; *k* Morris Ashby, Ltd.; *m* W. T. Glover & Co., Ltd.; *n* P. Ormiston & Sons; *o* Johnson, Matthey & Co., Ltd.; *p* The Phosphor Bronze Co., Ltd.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RECEIPTS.

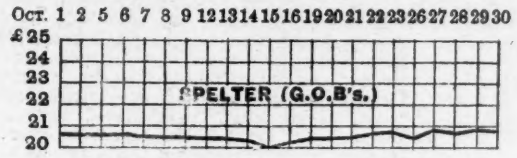
	Locality.	Week ending	Receipts for the week. £	Receipts for the week. £*	Total to date. £	Total to date. £*	Miles open.	*
	Aberdeen	Oct. 31	1,226	+353	28,449	+ 4,495	10	—
	Birmingham	,, 31	5,207	+ 9	224,069	+ 9,104	—	—
	Bournemouth	,, 28	877	—	—	—	10½	—
	Blackburn	—	—	—	—	—	12½	+1½
	Blackpool	,, 29	386	+ 20	35,288	— 199	8½	—
	Blackpool and Fleetwood	,, 31	272	+ 14	19,248	— 186	7½	—
	Blackpool and Lytham ..	,, 31	159	+182	12,505	+ 6,498	—	—
	Bolton	Nov. 1	1,790	+ 87	58,263	+ 7,342	25	—
	Bradford	—	—	—	—	—	41	+4
	Brighton	Nov. 1	861	+ 64	43,545	—	6½	—
	Bristol	Oct. 30	4,625	- 178	—	—	28	—
	Burnley	,, 31	420	+141	—	—	7½	—
Co.	Barnsley District	,, 28	175	—	7,700	—	4½	—
Elec. Trac.	Devonport	,, 23	506	+ 66	19,486	+ 935	5	—
	Dudley—Stourbridge ..	,, 18	831	+116	25,749	+ 8,530	18½	—
	Gateshead	,, 28	942	+ 80	37,117	+ 4,984	10½	+ ½
	Gravesend—Northfleet	,, 28	283	+ 36	10,372	+ 1,005	3½	—
	Greenock—Pt. Glasgow	,, 28	514	+ 64	23,488	+ 1,822	7½	—
	Hartlepool	,, 28	259	+ 46	11,606	+ 667	6½	+2
	Kidderminster	,, 28	111	+ 4	5,675	+ 182	4½	—
	Merthyr	,, 23	108	+ 22	8,472	— 169	3	—
	Middleton	,, 28	285	+ 32	13,822	+ 1,700	8½	—
	Oldham—Ashton ..	,, 23	571	+ 19	24,876	+ 1,548	8	—
	Peterborough	,, 23	127	—	6,385	—	—	—
	Poole	,, 28	274	+ 28	13,202	+ 1,966	3½	—
	Potteries	,, 28	1,678	+ 84	66,885	+ 3,497	20½	—
	Rothesay	,, 28	46	— 1	6,642	+ 1,602	2½	—
	Sheerness	,, 31	60	—	2,583	—	2½	—
	Southport	,, 28	274	+ 38	13 648	+ 2 488	3	—

* Compared with the corresponding period of 1902.

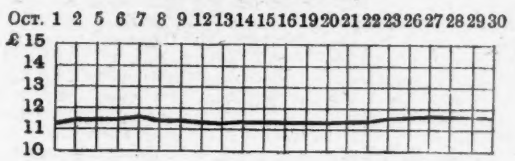
	Locality.	Week ending	Receipts for the week. £	Receipts for the week. £*	Total to date. £	Total to date. £*	Miles open.	*
	South Staffordshire ..	Oct. 23	1,042	+325	38,501	+ 5,977	21½	−½
Co.	Swansea	,, 28	518	+ 64	22,246	+ 1,879	5½	—
	Taunton	,, 28	58	—	2,687	— 194	1½	+1½
B.E.T.	Tynemouth	,, 28	260	+ 18	13,781	+ 883	3½	—
	Weston-super-Mare ..	,, 21	47	—	5,465	— 491	2½	+2½
	Wolverhampton Dist.	,, 28	394	+ 92	16,712	+ 7,485	10½	+8
	Wrexham	,, 28	131	—	4,288	—	—	—
	Yorks. Woollen Dist. ..	,, 28	527	—	13,220	—	6	—
	Cardiff	,, 24	1 927	+422	60,286	+17,380	14	—
	Chesham & District Co.	,, 22	549	+ 42	22,921	+12,974	8·53	—
	Dover	,, 24	185	— 16	9,709	+ 97	3	—
	Dublin	,, 30	4,364	—109	95,550	+ 7,451	45½	+ ½
	East Ham	,, 31	613	+158	21,405	+ 6,336	5	+ ½
	Glasgow	,, 31	13,996	+1236	392,324	+32,908	66	+ 9
	Hull	,, 31	1,985	+202	58,212	+ 3.002	11	+ 1
	Ilkeston	,, 28	180	—	—	—	4	—
	Isle of Thanet	,, 31	857	— 22	31,137	— 1,606	10½	—
	Leeds	,, 31	5,307	+246	175,259	+10,936	41	—
	Liverpool	,, 24	10,081	+112	434,121	+14,133	103	—
	Manchester	,, 31	11,591	+6275	367,188	+228,290	72	—
	Newcastle	,, 31	3,664	+597	—	—	17	—
	Portsmouth	,, 31	1,494	+117	—	—	22	—
	Salford	—	—	—	—	—	30	—
	Southampton	,, 29	969	+ 4	—	—	9	—
	Sunderland	Nov. 1	1,072	+ 9	39,592	+ 1,957	20	+3
	Central London Railway	Oct. 31	6,746	—409	111,066	— 5,999	6	—
	City and S. London Ry.	Nov. 1	2,799	—495	45,880	— 7,110	6½	—
	Dublin and Lucan Elwy.	,, 1	94	— 16	2,473	+ 142	6½	—
	Liverpool Overhead Ry.	,, 1	1,588	+ 61	30,358	+ 1,965	6	—

METAL MARKET.

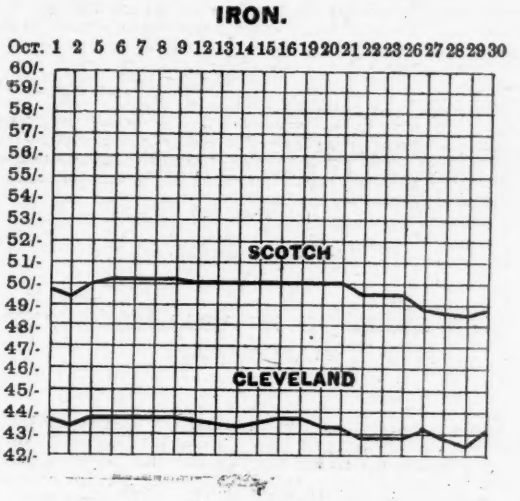
Fluctuations in October.



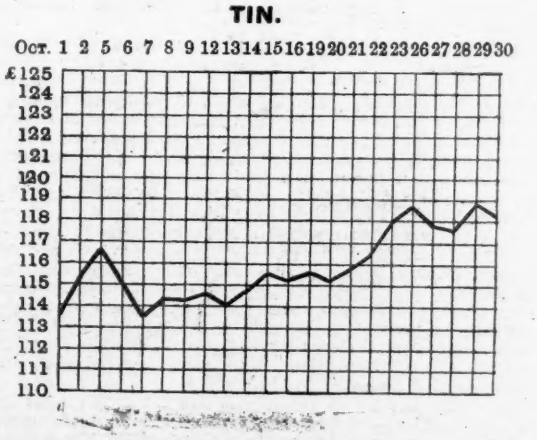
LEAD (ENGLISH).



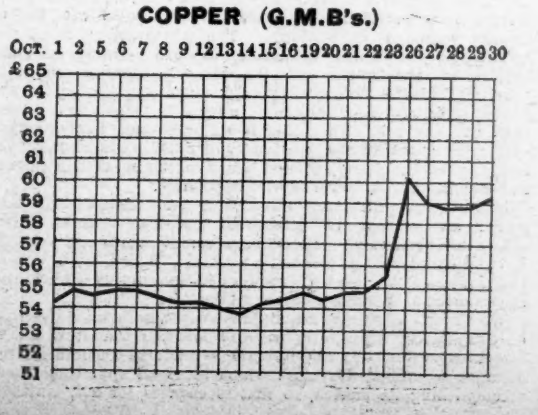
IRON.



TIN.



COPPER (G.M.B's.)



SOME NOTES ON STEAM TURBO-ELECTRIC GENERATING PLANTS.

The following discussion took place on Mr. Wilkinson's paper, which we published last week:—

Mr. Wilson Hartnell said that he would like a little more information, especially on the small points in which Messrs. Willans and Robinson's turbine differed from the Parsons. In conversation with Mr. Robinson he had told him that he thought the time for reciprocating engines for electrical work was slowly coming to an end, and he himself fully recognised this fact. One point he might mention was that of driving at a uniform speed. He mentioned a town where there were 50-h.p. motors driving direct, which had given trouble owing to the pinions wearing as much on the back as on the front side.

Mr. Holiday said that he had been using Parsons turbines at a colliery since 1895. When asking for quotations for reciprocating engines and turbines, the reciprocating engine-makers told them that they could not do a worse thing than get a Parsons turbine for power purposes, but in spite of this they got two 150-kw. machines and were so pleased with them that they had now got more, the largest being about 300 kw. A little difficulty was experienced at first with the very varying loads, due to the armature connections breaking off at the commutator. This was owing to insufficient flexibility, but it was overcome, and since then the trouble had not recurred. He had some reciprocating engines driving dynamos, and the attendants said they would rather run the whole of the turbines than one of the reciprocating engines. He mentioned that Messrs. Parsons had fitted an automatic brush rocking gear, which consisted of a piston with a spring on the top. It always drew the brushes back to the proper position as the steam pressure on the first blade was always proportional to the load. There was a pipe from this first row of blades underneath the piston, the steam from which always worked against the piston rocking the brushes. This had been running for 18 months and had caused no trouble whatever. He mentioned a rather curious fact, namely, that there was one megohm of resistance between the steel spindle of the turbine and the frame of the bearings in which it was running, the film of oil on the bearings being sufficient to insulate the shaft.

Mr. S. D. Schofield said that one great advantage of the turbine was its low first cost, and the inexpensive foundation required. The machine itself in the smaller sizes could be moved to suit the pipe work, condensers, &c. Some 12 months ago he had occasion to borrow a 120-kw. machine from Messrs. Parsons, until they could deliver a larger size, and to save the expense of special pipes he borrowed a number of scrap 12-in cast-iron pipes, bolted them together the best way they would fit and then set the machine to suit them. With reference to the suggestion that in the Curtis turbine the condenser cannot be driven from the shaft, he would suggest that a separate motor-driven condensing plant was much better, as he found that even driving the force pumps at times spoilt the governing of the machines. With regard to the claim that no expensive cylinder oil was necessary, he said that an expensive lubricating oil *was* necessary. On two occasions he had had trouble with oil, once due to the water and oil combining, and the second time to impurities in the oil attacking the cast-iron reservoir and choking up the oil passages. He had found it a good thing to draw off a few gallons of oil each day, putting it into the filter, and making up the deficiency with filtered oil. With regard to superheating, he had tried one machine with steam superheated over 600°, and had not had the slightest trouble with the blades. The tests on a 200-kw. machine worked out as follows:—

Date of test.	Steam pressure.	Superheat. Degrees F.	Vacuum in inches.	Load in kw.	Speed.	Lbs. of steam per kw.-hour.
Jan. 8, 1903	150	56	26·5	½ load	3,000	26·6
	150	56	26·5	Full	3,000	22·23
	150	166	26·5	½ load	3,000	24·41
	150	181	26·5	Full	3,000	20·39

Note.—Excluding power for air and circulating pumps. Decrease of steam consumption for higher superheat — 8·8 per cent.

Mr. Stoney said that, with respect to economy of space, both Parsons and Curtis turbines were exactly the same, whilst the Curtis was double the height, and therefore took up double the amount of engine room. He would also like to know how the Curtis turbine of old could be taken to pieces when anything went wrong, as it appeared to him that the whole of the alternator would have to be lifted off. With regard to a vertical clearance of about $\frac{3}{100}$ in., he would like to know how they managed to obtain such a small clearance as that. With reference to the last page in the paper, he said that those tests were made on a 1,500 kw. machine, and results obtained now were 2 per cent. better than those, which were made 16 months ago. Regarding the oil consumption, he said that he had both reciprocating engines and turbines, and they saved £5 a week in oil for a load of 600 kw., being equivalent to a steam consumption of 2 lbs. per kw.-hour less.

Mr. Jackson said that the Curtis turbine was in no way an infringement of the Parsons patents. On page 2 he read that, in order to get the steam consumption he must multiply by 10 and divide by 6, but he would suggest that the figure be increased to 7, otherwise, it put the efficiency of the generator rather too low. He said that the friction with the Curtis turbine was so small that they could turn the governor balls round by hand. The Curtis people would shortly deliver a continuous current turbine in which he thought they had overcome certain difficulties peculiar to that type.

Mr. W. J. A. London, referring to the De Laval steam turbine, in which there was only 2 mm. clearance between the exhaust end of the nozzle and the wheel, said that he had always understood that steam issuing from a properly constructed nozzle flowed in a parallel stream for a considerable distance; and that a clearance of 20 mm. or so could be allowed without decreasing the efficiency. To bring out the point of parallel running still more, he would like to mention the instance of the Parsons-Brown-Boveri turbo-generator of 3,000 kw. installed at Frankfort. This machine was started up and put into parallel with a slow speed machine without the slightest difficulty and without assistance from the turbine expert. He referred to the difficulty of dismantling a vertical turbine, and thought that it was very much more difficult to dismantle than the same machine would be if built on a horizontal plane. Referring to the Westinghouse turbine, he said that the new machine was a modified combination of the De Laval and Parsons type, steam entering at the centre of the cylinder and issuing both ways through a series of stationary and revolving nozzles, the low pressure expansion being taken care of by Parsons blades. The Westinghouse people had recently guaranteed on an 1,800-kw. machine, with a steam pressure of 180, vacuum 27½ in., and superheat of 150°, 16·4 lbs. per kw.-hour. The overall length of the 5,500-kw. turbine for the London Underground Railway would only be about 40 ft., which compared favourably with any slow speed horizontal reciprocating steam engine. The total weight of the combined plant was about 200 tons, being about one-third of the 3,500-kw. Sulzer-Kolben plant. He failed to see how any additional ventilation was obtained in the Curtis turbine, because with the generator placed directly above and the steam entering at the top, one would think there would be a great deal of radiation, and that the hot gases from the turbine would rise and heat up the generator to a greater extent than in a horizontal machine. With reference to oil economy he gave the following results, which he obtained whilst with a Continental firm, the machines being of 1,000 kw. output:—

Reciprocating engine plant:—Per day's run of 24 hours:—4 gallons engine oil; 4 gallons cylinder oil; 4 gallons filtered oil.

Steam turbine:—·8 gallon engine oil; ·4 gallon cylinder oil.

Assuming a station of 10 units of 1,000-kw. reciprocating plant, and taking an average price for oil, and assuming the machines to be giving two-thirds of their output all the year round, the oil bill for the year would come out about £2,300, whereas that of a turbine station would only be about £300. Considering the London Underground station consisted of a total of 44,000 kw., the saving would be quite a big factor, and he thought that the oil consumption was a point which should receive more consideration than it does.

Mr. A. B. Mountain said that the figures given to them, showed what excellent results could be obtained providing the superheat was very high, but what was the difference in the coal bill? They knew that a certain amount of coal had to be burnt to produce superheat, and he thought it was unfair for the author to compare the Sulzer plant with the Parsons plant, because in the one case he had a plant with saturated steam, and in the other case one with 100° superheat. And, again, in one case there was 4 in. more vacuum than in the other. He thought that the Curtis turbine would have a larger diameter than the Parsons. The other day he had a steam leakage of something like $\frac{1}{100}$ in., and he was astounded at the amount of steam which could pass through that little space. It was obvious that if the diameter were increased, the leakage past the edge was also increased.

Mr. Samuelson said that by superheating 100°, the steam consumption was reduced 1 lb. Previous speakers had alluded to the fact that they could not superheat without some expense. Assuming the consumption to be 19 lbs., and that they had improved the efficiency 10 per cent. This 10 per cent. was made up as follows:—Four-tenths had been added in heat, and more coal had had to be put on the fire, but 2 per cent. more was obtained from the superheated steam. The quality which this steam had, gave another 2 per cent., because when wet steam went through the machine the friction was very much greater than when the steam was dry, and thus nearly 6 per cent. represented the total gain. He then gave some tests on a 500 kw. Curtis turbine, the steam pressure being 150 lbs., superheat 150° and vacuum 28½ in. The full load consumption was 18·75 lbs. of steam, half load 20½, and quarter load 22¼ lbs. The turbine was underrated, as it was really a 750-kw. machine, and could be run up to 900. For 50° of superheat he had obtained 9½ per cent., and for 100° 14 per cent. improvement in steam consumption. With reference to the machine being taken to pieces, there had been no occasion to do so since it was erected; should it be required it was only necessary to lift the generator up a couple of inches or so, when the turbine could be readily got at. In this machine the temperature was not high inside, as in the Parsons, being only 220°. He should like to add that the machines were designed to give full load when running non-condensing; that meant that the steam only did half its work. The weight of a 1,500-kw. machine was 60 tons, and of a 3,000-kw. 130 tons. He also added that the blades on the wheels were cut from the solid so that they would stand any amount of superheat.

Mr. Barker said that it was his privilege to have been the station engineer of the second turbine station in this country, and the history of that station (Cambridge) had been a continued success. The coal costs were rather high, the output being less than 500,000 units. The station was two miles away from the centre and transmitted a quarter of a mile before getting to a consumer. The centre of the town was composed of colleges, and the density factor could never be high. The coal cost of ·66d. per unit sold would have been equal to ·5d., if it had been direct current. Another thing was that the coal cartage was 8s. per ton from the pit to the station, whilst in that district, with cheap coal, the cost could be brought down to something like ·25 or ·2d. per unit. He said that the blades in the Parsons turbine did not come out, although on one or two occasions they had broken off, due to faulty material, but such a thing was nearly unknown in the Parsons turbine.

Mr. Wilkinson, in reply, said that he did not anticipate any difficulty in replying to criticism, inasmuch as the subject matter consisted largely of statements and facts. He did not agree with the view of some speakers that the days of the reciprocating engine, so far as electric power stations were concerned, were numbered, as notwithstanding the assurances which had been given that all the objections named as to the fitness of steam turbines for driving direct current generators were surmounted, there was no doubt that the future of direct current generation lay with the slower reciprocating engine, at least, until a type of turbine was perfected to run economically at speeds not exceeding 500 per minute. Automatic rocking gear for the brushes of direct current generators, operated by a piston in a steam cylinder connected to the turbine side of the throttle valve governor had been named, but this was a makeshift device, and did not get over the difficulty of excessive wear and tear on the commutators and collecting brushes. He regretted that they had had no definite information given them as to the effect of high superheat, and he would suggest that it would be highly interesting and useful if they could have a paper dealing with the economies of superheat, both with reference to steam turbines and reciprocating engines, setting forth exactly at what point the advantages of superheating were nullified by the increased consumption of fuel to produce such superheat. It had been suggested that it was unfair to compare the steam consumption of the Sulzer-Kolben plant with the Parsons plant, inasmuch as the results in the latter were obtained by superheating 100° with a 4-in. better vacuum, but he contended that it was useful to compare results obtained in actual practice. It would be interesting to know why advantage was not taken in the Sulzer engine of the increased economy obtainable by superheating. Possibly it was not easy to improve the vacuum on the reciprocating plant, whereas one of the advantages of turbines was that no air was drawn into the condenser. A fertile cause of low vacuum in reciprocating plants was air leakage at the low pressure piston rod and valve packings, and in such cases he found it of great advantage to water-seal the packings at the low pressure end, especially in the case of engines with metallic packings. Recently in a 600-h.p. plant he obtained by this means 2½ in. increased vacuum in the condenser.

ARC LIGHTING IN WILLESDEN AND HAMPSTEAD.

A large installation of arc lamps for the lighting of Kilburn, Harlesden, Hampstead and Willesden has been carried out during the past year by the Gilbert Arc Lamp Co., Ltd., of Chingford, for Mr. E. T. Ruthven Murray, of Willesden, and Mr. G. H. Cottam, engineer to the Hampstead Borough Council, in which many of the company's most recent improvements and inventions have been introduced.

The Hampstead lighting consists of lamps run in series off a constant pressure of about 1,800 volts, special machines being provided in the Borough Council's alternating station to supply direct current at this pressure. The Kilburn and Willesden lighting is carried out with lamps in series off a constant pressure of 480 volts.

All the lamps are similar and interchangeable, and are fitted on similar posts, one of which is shown in fig. 1; they are further provided with lowering gear, which is a special feature of the Gilbert Arc Lamp Co.'s system, and has been adopted on almost all the important work which that company has carried out during the past two years. The external appearance of this gear can be seen in the illustration, and it will be noticed that it is very neat and unobtrusive, although it is of exceptionally strong construction. It is mechanically very simple, stout double cord being used for suspension, which, whilst adding immensely to the strength at very slight expense, also avoids any twisting of the lamps, and allows plain knife switch contacts to be used, which can be effectively insulated. When the lamp is in position it is supported independently of the cord by special catches.

The lamps used are of the Gilbert Arc Lamp Co.'s usual type, containing their latest improvements, and the Hampstead engineers, who have ammeters continuously in their circuits, have expressed themselves as particularly impressed with the steadiness and uniformity obtained in working. The improvement is obtained by paying as much attention to the strike or retrace portion of the motion of the lamp mechanism as to the "feeding" itself. The usual positions and ideas are quite abandoned, and a very slight electrical alteration is able to completely open out the arc. That this is an important improvement is evidenced by the unusual uniformity of circuits composed of these lamps, which enables the Gilbert lamps containing 6 ft. of carbon to run satisfactorily, a feat otherwise impossible.

Most of the pillars are fitted with two incandescent lamps, which are carried in substantial cast-iron fittings, forming also suitable reflectors. These incandescent lamps are controlled by "Gilbert" patent automatic switches, which have got over the troubles which beset the earlier attempts in this direction, and are reported as satisfactory from all quarters.

We may on a future occasion give a separate detailed description of this switch, but shortly we may mention that it is a simple direct magnetic switch, and its action is rendered controllable from a distance by means of a catch which takes an appreciable time in accomplishing its motion, so that it engages, or not, leaving the

switch open or shut in response to a short or long application of electrical power to it. The arrangement is contained in a neat cast-iron box 8 in. × 4 in. × 4 in., and can be seen in our illustration of the

Fig. 1.—Gilbert Arc Lamp Column, Willesden.

"post gear," fig. 2. The box also contains double-pole fuses and convenient terminals.

There is rather a large amount of gear in most of these posts, and our illustration shows one of the most complicated. It will be seen

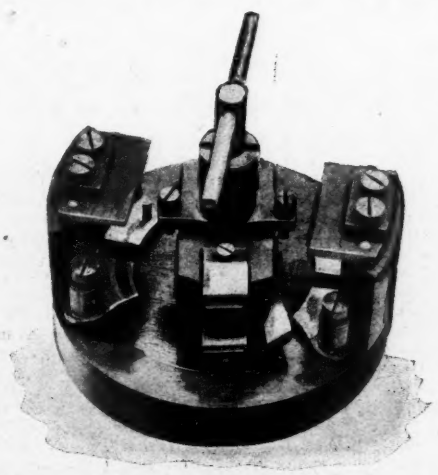


Fig. 3.—Special Switch.

that all the apparatus is made up into one complete gear, and each set of apparatus is fixed into the post-base by two bolts.

All the units are specially designed and made by the company with a view of being used together. They are provided with porcelain bases, giving a high degree of insulation, and are assembled on a light iron frame; they are easily attached or detached individually. The frame is fixed to a shaped wood block which is bolted to the post.

All resistances are specially kept well away from both the wood and the various cables. An umbrella is provided to keep any direct water off. The first apparatus which will be seen below the winch is the "Gilbert patent automatic switch" described above, and used for controlling the incandescent lamps by means of the arc lamp circuit; beneath that is a special switch carrying out all the operations required in an arc lamp-post (fig. 3). It is a turn switch, mounted on porcelain and provided with a quick break. The switch is double-pole, double-break and capable of dealing easily with 20 amperes at 500 volts. The switch acts necessarily as a starting switch, utilising the compensating resistance as a steadying resistance, *i.e.*, switching on at the first position 9 lamps out of 10, plus one substitutional resistance; in a few moments the 10th lamp can be put in, in place of the resistance. This is always useful, and particularly so with such powerful and long range sensitive lamps as the Gilbert lamps. Of course, this switch will also act as a switch to cut the lamp out of circuit if required. The next porcelain base carries the automatic cut-out and strong terminals, capable of gripping and supporting the leads, which are also provided in all the apparatus. The chief features of the cut-out are the absence of any part likely to stick or jam, and its unusual power, enabling a stiff rubbing contact of bronze to be used having a definite self-cleaning rub, which

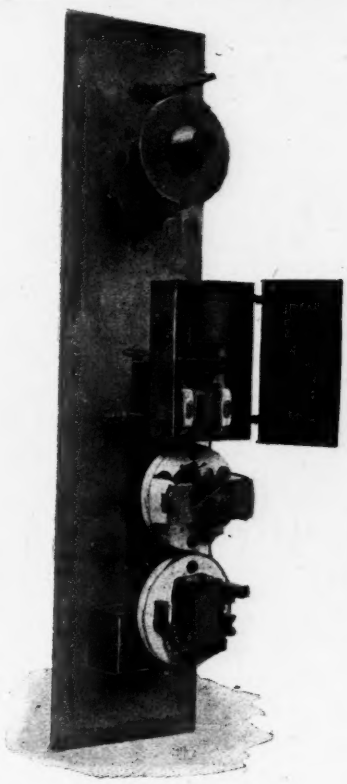


Fig. 2.—Arrangement of Apparatus (on Temporary Support) as in Base of Lamp Column.

the firm have found to be more satisfactory than any touching contacts of carbon or any special metal. The resistances are made of steel wire wound on the usual spiralled porcelain formers, care being taken to securely clamp them from end to end so that there is no harm done should they crack from the heat.

PRACTICAL EXAMPLES WITH THE CALCULATOR BOARD.

By Edward Raymond-Barker.

Series I.—*Notes for Submarine Cable Staffs.*

(*Continued from page* 723.)

Coefficients for Temperature Correction of Resistance Coils Wound with Various Alloys.

If, for instance, bridge coils be used at a temperature higher or lower than that at which they are correct, a certain correction has to be added to, or subtracted from, the observed bridge reading. In the case of German silver, platinum silver, or platinoid, the correction is appreciable. Manganin, however, has so low a coefficient, that the said correction becomes unnecessary.

Mr. John Gott has shown, in the Electrical Review for February 14th, 1902, how, by the addition of a small box containing 10^{ω}, 100^{ω}, $1{,}000^{\omega}$, and $10{,}000^{\omega}$ coils of manganin as ratio coils on the cable or (x) side of the bridge, there is no occasion for the temperature of the bridge coils to be observed, with whatever alloy they may be wound, for, with this arrangement, the bridge system automatically corrects itself.

In the many instances where correction is still necessary, the calculator board curves offer great facilities for such an operation.

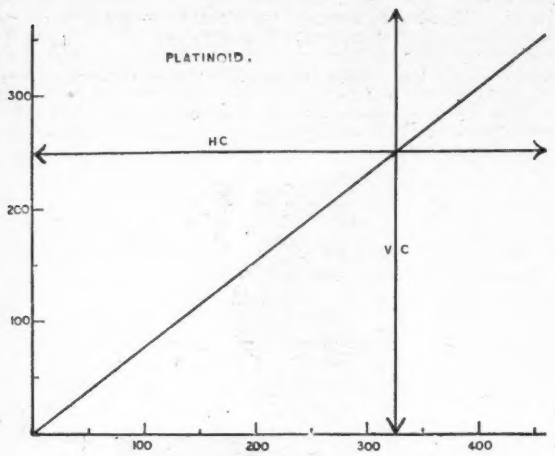


Fig. 23.

Example 14.—(Fig. 23.)

A bridge with platinoid-wound coils correct at 60° F. gave at 85° F. 2,133·66 ohms as CR of a cable. Required correct CR.

Note.—Temperature conversion curves for

1. German-silver.
2. Platinoid.
3. Platinum-silver.

Ordinate :—G_4, 100 = 10° F. difference in temperature.

Abscissa :—g_3. 100 = 0·001 (+ 1) = coefficient by which bridge readings must be multiplied, or divided, as the case may be.

On scale g_3, according to the above figures :—

100 = 1·00100
200 = 1·00200
255 = 1·00255
385 = 1·00385
460 = 1·00460 (limit of actual scale g_3)
755 = 1·00755 (On second portion of scale, if extended, as is the case with the German-silver curve on the sheet)

In the present example, difference of temperature involved is 85° — 60° = 25° F.

Bring H.C. to 250 (= 25°) on omnibus scale G_4.

To point where H.C. intersects curve for platinoid bring V.C. so that H.C, V.C, and platinoid curve intersect at a common point.

At lower extremity of V.C. read 325, that is, 1·00325.

Then 2,133·66 × 1·00325 = 2,140·5 ohms, which is bridge reading corrected for the fact that the reading was noted at a temperature 25° F. higher than that at which bridge coils were known to be correct.

Checking by logs, as generally employed :—

	log.	log.	log.
2,133·66	3·32913	+ 0·00141	= 3·33054 = 2,140·6 ohms.

Example 16.—(Fig. 25.)

A cable electrician is called upon to use a Wheatstone bridge fitted with a thermometer graduated in degrees Centigrade. The bridge is marked correct at 15·5° C.

Temperature at which test is made, is 29·4° C.

Difference = 29·4 — 15 5 = 13·9° C.

It so happens that all available tabular data to hand are compiled in terms of degrees Fahrenheit.

Then, given difference of 13·9° C., required equivalent difference in degrees Fahrenheit.

Ordinate :—G_4 100 = 10° F. difference in temperature.

Abscissa :—g_3 100 = 10° C. difference in temperature.

Bring V.C. to 139 that is 13·9° C. difference on *omnibus* scale g_3.

To point where V.C. intersects curve (clearly indicated on sheet) bring H.C. so that the two cursors, and the curve intersect at a common point.

Then at the left extremity of H.C. read 253, that is, 25·3° F., a difference in temperature equivalent to 13·9° C.

On occasions, when it is necessary to reverse this operation, H.C. is first brought to difference in degrees Fahrenheit. Then V.C. is brought to the point where H.C. intersects curve. Then at lower extremity of V.C. is read equivalent temperature difference in terms of degrees Centigrade. Obviously all calculator-board computations may be easily reversed.

For instance—to go back, at random, to a former example—say, Example 4, K was computed in terms of *n*.

Let it be supposed that data relating to *n* had been lost, whilst numerical equivalent of K was still known. Then by reversing the afore-described manipulation of the "board," *n* can be ascertained from K.

Example 17 :—

To convert, by the board, degrees F. to degrees C. or *vice versâ*, operation is simple.

Given 57·3° F.——? C. 57·3° F. — 32 = 25·3, (by cursors and curve) = 13·9° C.

Given 13·9° C.——? F. By cursors and curve 13·9° C. = 25·3 (+ 32) = 57·3° F.

In the foregoing examples the calculator board has been considered and utilised as a compendium of useful data under the highly condensed form of curves. The numerical

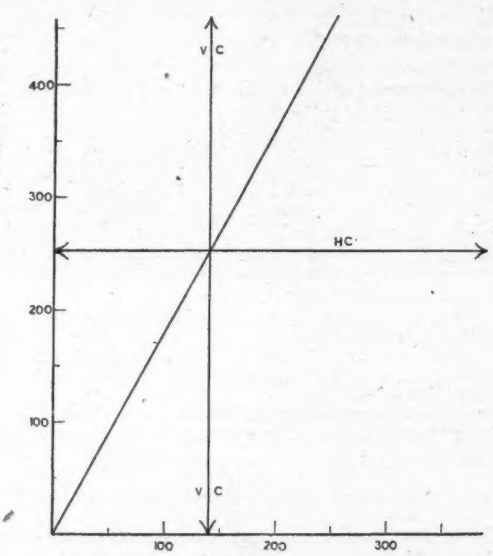


Fig. 25.

values evolved out of the varied relationships between ordinates and abscissæ have been computed by the mechanical operation of two intersecting cursors.

The following example will show the calculator board under a two-fold aspect :—

First:—That of a curve-record of useful data.

Secondly :—That of a working board on which fresh curves can be plotted in pencil for the investigation of certain points of inquiry : the said pencil curves to be erased, once their purpose has been served, or when tracings have been made from them to serve as a permanent record.

Jona Localisation Curves.

These curves are derived from Wheatstone bridge tests to scale zero (in the first mentioned case) with various currents on core $\frac{500 \text{ lbs. Cu.}}{315 \text{ lbs. G.P.}}$ per N.M., cut flush, and immersed in salt water.

Resistance inserted between bridge and core approximately 2,000 ohms.

The following examples are given not so much to illustrate any special localisation methods, but to afford practical proof of the immense facility for expediting work by quickly plotting down values on a matt surface of celluloid sheet, possessed, at one and the same time, of the advantages of accurately graduated sectional paper, and of a common working slate with an ever renewable surface.

These graphic methods, whilst economising time, add a fascinating interest to the work. This interest grows on the worker as the general trend of the plottings becomes apparent, and, without any irksome calculation or fumbling

with logarithm books, the unknown x is indicated by a digit-like curve—the resultant of a few plottings.

As shown by Jona, current and resistance values may be plotted on sectional paper, when the points plotted will be found to trace a curve in the direction of the point on the line of cable conductor resistance, representing the true ohmic value up to the break.

Example 18 :—

The following are figures from actual tests to scale zero :—

November 14th.			November 19th.			November 21st.		
ma.		ohms.	ma.		ohms.	ma.		ohms.
17·42	gave	2,064·5	17·16	gave	2,061·5	17·24	gave	2,061
8·38	„	2,095·5	8·262	„	2,094·4	8·352	„	2 092·7
4·095	„	2,148	3 997	„	2,151	4 094	„	2,146·4
2·026	„	2,232	1·895	„	2,247·5	2·000	„	2,232·5

Jona has also pointed out that a conveniently restricted and compact curve may be obtained if current values be plotted in terms of $\frac{1}{\sqrt{\text{ma.}}}$ instead of in terms of ma.

The corresponding factors—current and scale zero bridge-readings—now become :—

November 14th.		November 19th.		November 21st.	
$\frac{1}{\sqrt{\text{ma.}}}$	ohms.	$\frac{1}{\sqrt{\text{ma.}}}$	ohms.	$\frac{1}{\sqrt{\text{ma.}}}$	ohms.
0·240	2,064·5	0·242	2,061·5	0·241	2,061
0·345	2,095·5	0·348	2,094·4	0·345	2,092·7
0·494	2,148	0·500	2,151	0 494	2,146·4
0·703	2,232	0·726	2,247·5	0·700	2,232·5

To obtain the foregoing values for $\frac{1}{\sqrt{\text{ma.}}}$ by the "board" procedure was as follows :—

Ordinate :—Scale G_2 graduated in milliamperes (ma.)

Abscissa :—Scale g_5 graduated 1 to 0·01.

Curve :—That marked $\frac{1}{\sqrt{\text{MA.}}}$

These give corresponding numerical values for the expression $\frac{1}{\sqrt{\text{ma.}}}$, with a range for ma. from 1 ma. to 46 ma.

To take one of the foregoing examples—say the test made on November 14th—see previous table. To solve $\frac{1}{\sqrt{17{\cdot}42}}$ (fig. 26)—

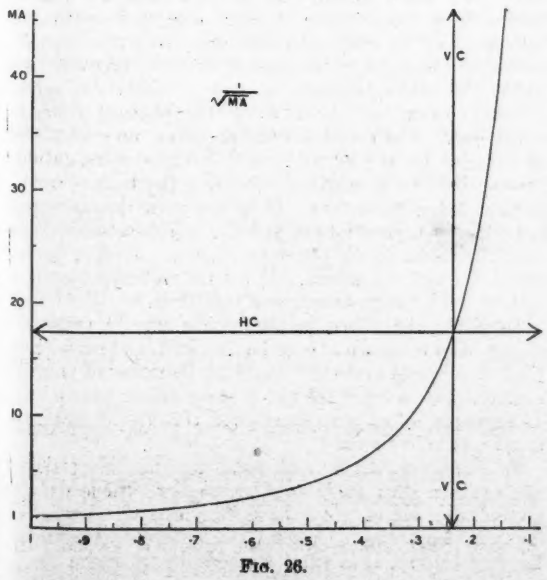


FIG. 26.

Bring H.C. to 17·42 on the ordinate scale for milliamperes (ma.) viz., scale G_2.

To point where H.C. intersects curve $\frac{1}{\sqrt{\text{ma.}}}$, bring V.C., at lower extremity of which read answer 0·240.

A passing check by logs., merely for the purpose of these notes, corroborates the sufficient accuracy of the above figure.

log.	log.
17·42 1·24105 ÷ 2	= 0·62052 = 4·1737
1 ÷ 4·1737	= 0·2396.

All the other $\frac{1}{\sqrt{\text{ma.}}}$ having, in like manner, been derived from the three other ma. values, viz :—

ma.	$\frac{1}{\sqrt{\text{ma.}}}$
8 38	0·345
4 095	0·494
2·026	0·703

matters are ready for the plotting of Jona localisation curves for the three dates aforementioned.

(*To be continued.*)

THE MULTIPLE SUPPLY ELECTRIC RAILWAY SYSTEM.

[COMMUNICATED.]

THE comparative success of the experiments recently made in Germany in the matter of the application of electric traction to railway trains, and the very high speed attained during these experiments, has excited renewed interest in this fascinating field of electrical work. Before describing another attempt at a solution of the problem of the use of electricity on roads now operated by means of steam locomotives only, it may be well to first consider the objections which may be urged against the system which has been tried by our Teutonic neighbours.

In the German experiments, high voltage transmission by means of three-phase currents was employed, current being collected from three horizontal stretched wires by means of a modification of the well-known Siemens sliding bow, and a working pressure of 10,000 volts being supplied to the motors. Such an arrangement necessarily involves serious difficulties in insulation, it having been found on other roads in Switzerland and Italy that the pressure of the sliding contacts and the surging of the train frequently cause breakage of the insulators. The difficulties of construction, moreover, are still more serious, especially in tunnels, station yards, where a multiplicity of tracks and sidings may exist, and at bridges or crossings. These difficulties of construction are aggravated by the fact that, in order to obtain a safe distance between the conducting wires, the mast carrying the sliding contacts must be fully 25 ft. above the track, while in the German experiments it was probably more. Should, however, the constructional difficulties be successfully overcome, there still remains the extreme liability to breakdown inherent in all purely high voltage systems from the effects of gales, rain, snow, sleet and lightning, to say nothing of the more common accidents to which the combination of generating plant, transmission line, transformers and train motors is subject. It is well remembered that the great power transmission plant at Niagara Falls was shut down some time ago for 36 hours from the effects of lightning, while the New York elevated roads have been helpless on several occasions from the presence of sleet frozen on the conducting rail. In England, in January last, practically the whole country was covered with a glaze of ice for many hours, and on that occasion, had any existing system of electric traction been in general use, our railways would have been in serious difficulties. It may be doubted, therefore, if conservative British railway directors will ever adopt any system of electric traction not affording the same certainty of operation and the same security against breakdowns as is now obtained with the reliable steam locomotive. If such a system can be had at a reasonable first cost, which may be operated much more cheaply than the steam locomotive system, then we may see electricity used on our great trunk lines; but existing systems do not offer these guarantees.

The method herein briefly described, which has been called the "multiple supply system," is an attempt to solve the problem on hitherto untried lines. To realise the primary condition—that of absolute safety and certainty of operation—it is necessary that all trains shall be, to a large extent, self-contained—that is, they must be able to propel them-

selves for a certain distance irrespective of the conducting line. To secure this condition, it is proposed to utilise the remarkable properties of the new Edison storage battery, employed as an adjunct to a suitable system of long-distance transmission.

It is not necessary here to discuss the merits of Mr. Edison's latest and greatest invention, as these will shortly be placed before the engineering profession in great detail by others. It may be said, however, that the severest tests on the most difficult form of traction work—that of driving automobiles over common roads and severe gradients—have shown without question that similar batteries, used on smooth rails and easy grades, solely as an aid and adjunct to other methods of propulsion, will have an almost indefinite life. As extreme lightness is naturally desirable in a battery which must be carried on the train itself, it is gratifying to find that a total weight of 20 tons of Edison battery will propel a train weighing 200 tons for a distance of 50 miles on level track at a speed of 75 miles per hour, without any assistance from an external source of energy; and that this weight added to that of the necessary electric locomotive, with motors, &c., is considerably less than that of steam locomotives, with tender, coals and water, able to do similar service. If, however, this weight of battery be used solely as an adjunct to a system of line supply, then the total train weight may be increased to 300 or 350 tons, while the battery on one charge will cover a distance of from 300 to 400 miles, and still retain its ability to propel the train for distances of from 30 to 50 miles in case of a total failure of the line supply. That is, we may retain the advantages of high voltage transmission with the certainty that in case of accident thereto we may still propel our train to its destination, or over the defective section of line, at a reasonable speed.

But this is not enough; we must still secure great economy in construction and a greatly reduced cost of operation over steam.

These requisites are obtained on the multiple supply system in the following manner:—

On double track lines having a heavy traffic, such as are customary in England, a continuous current three-wire system of line transmission is proposed, the pressure between the outer conductors being 4,000 volts. The inner or adjoining rails of the line are bonded and cross-bonded to serve as a neutral conductor, and the up and down lines are operated by the positive and negative conductors respectively. As it is not believed that English methods of construction will ever tolerate the dangerous overhead wires proposed in Germany, a third rail conducting system would be employed, and special methods of insulation have been designed for this work. These third rails are entirely omitted at sidings, station approaches, on severe down grades, in tunnels or on bridges, at points where difficulties of construction may exist, as in station yards, and wherever their use may be specially dangerous to life. As the points at which third-rail construction is dispensed with are naturally those at which trains must necessarily run slowly, and consequently with a minimum of power, the train battery alone would be used at such places, the line current being automatically cut off before a third-rail section is passed and restored when a section is reached. The saving in third-rail construction on most lines would be about 40 per cent. of the total mileage of main and side track, but as a pressure of 4,000 volts is used in place of the customary 500, the total cost of construction would be greatly reduced, especially as the parts omitted are precisely those which offer the greatest difficulties in ordinary practice. In fact, it may be stated here that the saving as compared with the usual 500-volt system, using a conducting rail weighing 100 lbs. per yard, is more than sufficient to pay for all the train and reserve batteries required on a busy line operating heavy trains. The third-rail conductors would be laid in sections corresponding to the signal sections of the line, and each section would be electrically "dead" except when a train was in operation thereon. These sections would be supplied from generating stations located from 30 to 50 miles apart, through continuous conductors so arranged that any train could be supplied from either direction in case of a breakdown in a generating plant.

Each train locomotive would carry two sets of motors, one adapted to work with current from the high voltage line only, the other being supplied from the low voltage battery only. The batteries may thus work over a wide range of voltage, as the Edison battery may be discharged to zero without injury. As the batteries cannot discharge into the line under any circumstances, each train becomes, so far as they are concerned, an absolutely independent unit. These batteries may, however, be re-charged from the line when necessary, as they cannot be injured by overcharging at rates far in excess of the normal. The train motors would be so proportioned that the train could be operated at full speed on level track by means of the motors in connection with the line only, or with slight assistance from the battery-actuated motors. In starting from a station, or on upward gradients, the combined power of both sets of motors would be employed, the remarkable over-discharge rate of the battery being utilised so far as necessary. When standing at a station, power may be taken from the line to recharge the battery, and further recharging may be done by using the battery motors as generators on severe down grades, or in braking. As 40 per cent. of the line is not equipped with third-rail conductors at all, about 40 per cent. of the total number of trains on the line would be out of contact with the generating plants, and the latter may be made correspondingly smaller with a like saving in first cost. As current is taken direct from generator to train motor, the use of three-phase transmission and rotary converters is unnecessary. It will further be observed that the current supplied to trains from the generating plants is only that required to operate each at normal speed on level track, the excess power required at up grades and on starting from stations being supplied from the train batteries; this necessarily secures an even load factor, and avoids the necessity of using large generating plants. The constant load factor is further secured by the use of small stationary batteries at generating stations, and by the current-absorbing properties of all train batteries not in actual use. As few railway lines maintain in service a maximum number of trains for over 10 hours daily, the generating plants, if operated continuously for 24 hours daily, will do all the battery recharging necessary without any increase in the capacity of the plants—that is, small plants under constant load will do as much work, if operated continuously, as large plants now do when operated under a fluctuating load for shorter hours, but the small plant may readily cost from 40 per cent. to 50 per cent. less than the large one. In fact, the total cost of a system as described has been ascertained from known data to be about one-third that of the familiar three-phase rotary converter system for equal work.

On single-track lines having a comparatively light train service, or where power has to be transmitted for long distances, a single-phase system combined with train batteries may be used. In this case the trains would be started and brought up to speed by battery power only, after which the alternating-current motors would be kept in constant operation, regardless of the physical conditions of the line. The excess power required on up grades would be supplied by the battery, and the excess speed on down grades would be checked by recharging the battery from its motors used as generators. If for any cause the train should fall below its normal rate of speed, the line-actuated motors would be automatically put out of circuit. That is, the train would control the motors, and not the motors the train, the battery and its motors serving as regulators.

In either the direct or alternating current systems an almost ideal load factor may be expected, and consequently generators would preferably be driven by means of power-gas engines, thus securing the use of the cheapest known power. The economy of such a system over the use of steam locomotives is self-evident.

It will, of course, be understood that in this article no attempt has been made to describe the various details of control, &c., all of which have been carefully worked out. The vital feature is, of course, the independent relations of line and battery, as existing methods do not secure the best results from any battery, while they are wholly unsuited to the Edison apparatus. The amount of battery used on any train may be suited to the requirements of the line, and the elements need not be removed from the train for examination or recharging. As each cell may be made 6 ft. high, if necessary, little room is wasted, and the cost of hauling the batteries over the line is insignificant when power is produced

in the cheapest possible manner with a total elimination of the losses inherent in previous systems.

The essential details of the multiple supply system have been patented in many countries, and a demonstration of its capabilities will shortly be made on a large scale.

REVIEWS.

Spon's Engineers' Price-Book, 1903-4. By Thomas G. Marlow. London: E. & F. N. Spon, Ltd.

This is an exceedingly comprehensive volume, and it is within the reach of all to whom such a work at a very low price will appeal.

The volume is divided into three sections, as follows:—A price-book arranged alphabetically with cut and lettered index, for ease of reference; a directory containing the names of over 6,400 makers of engineering plant and material and their various specialties; and, lastly, a small trade-mark section.

As future editions are calculated to be more complete, and in some details more accurate, the volume is likely to become one of exceeding great value. In the present edition there is not complete accuracy in the names and addresses of some of the engineering firms included in the directory part, but this the author seems to have suspected to be the case when he wrote his preface. The electrical side of the work is not by any means its strongest, and it will become of more real value to the electrical estimator and engineer if it is made more complete in later editions. Surely alternating-current machinery, steam turbines, and vertical multi-cylinder gas engines are worthy of some notice in a work of this kind.

The volume is strongly bound and well printed, and considering its comparatively small price, it should command an extensive *clientèle*.

Engineering Preliminaries for an Interurban Electric Railway. By Ernest Gonzenbach. New York: McGraw Publishing Co.

This is an interesting and racy account of the writer's recommendations for a proposed cross-country electric railway in the Middle Western States. One cannot help being impressed with the facility with which they can "throw" such systems together in America. The writer's suggestions for adopting block signalling arrangements; above-grade crossings, rather than level crossings over steam roads; switch lights or alarm signals at level road-crossings; provision for attracting the drivers' attention by wayside passengers, &c., with cars which may run at any speed up to a mile a minute, quite refresh one's memory as to the mediæval state of affairs out West. This is further exemplified, in the arrangement of the sub-station feeding points, which are "only seven miles apart," and with the proposed service, the author does not anticipate a greater drop than 230 volts from the normal working voltage of 600.

Again, when calling attention to the deplorable condition of affairs on some interurban roads, the author cites a case where two cars were ordered by telephone to "kind o' look out" for each other on a dark and stormy night, each of the said cars regularly attaining upwards of 60 miles an hour. After this, even the most inveterate Board of Trade hater will be tempted to believe in the existence of blessings in disguise.

However, allowing for the conditions met with in American practice, there is still plenty of commonsense advice in the book, which might well be taken to heart by those concerned in similar work in this country.

Beginner's Manual of Submarine Cable Testing and Working By G. M. Baines. The *Electrician* Printing and Publishing Co., Ltd. Second edition. 7s. 6d. net.

That this manual has supplied a real want among students and employés of submarine cable stations—for whom it is especially suited—is shown by the favourable reception already accorded to the first edition. Its chief recommendation to "beginners" is the exceptionally lucid manner in which the principles of the various tests and the laws on which they depend are explained by the assistance of diagrams, and their formulæ illustrated by examples. This particularly applies to the chapters on the Wheatstone Bridge and Inductive Capacity.

While the object of the author has been to explain the tests and their formulæ step by step in the simplest way, and, at the same time, sufficiently fully to enable the student, whose knowledge of algebra is very limited, to acquire such a grasp of practical cable testing as will assist in the study of more advanced works, like those of Fisher and Darby, J. Elton Young, and H. R. Kempe—the so-called "Beginner's Manual" is considerably more than an elementary treatise, inasmuch as every branch of cable testing is dealt with, and most of the best methods for localising faults are included. While, therefore, it is in itself a comprehensive and tolerably complete work on testing for those who have to make the ordinary routine tests at a cable station and assist from the shore the electrician on board a cable-repairing steamer, the insight which it affords will encourage many to acquire a more extended and intimate knowledge of electrical testing, and themselves, in turn, to contribute to the advancement of this branch of science, for which their connection with cables affords peculiar facilities. The advantages, and, in fact, the supreme importance, of intelligent co-operation from those in charge of the cable stations on shore is only fully appreciated by the electrician in charge of the electrical work on a cable ship, and Mr. Baines is to be congratulated on having put into their hands a text-book at once so simple and comprehensive. To make the "Manual" subserve the requirements of those who have not only to test, but also to work submarine cables, Mr. Baines devotes two chapters in Part III. to the description and adjustment of apparatus used for signalling purposes, viz., the siphon recorder, Muirhead's automatic curb sender, cable duplex, signalling condensers, speed of signalling, various lightning guards, &c.; while the last chapter deals very shortly with the telephone, construction and working of accumulators, and the different windings of dynamos employed for an electric lighting plant.

Treatise on Thermodynamics. By Dr. Max Planck (of Berlin University), translated by Alex. Ogg, M.A., B.Sc., Ph.D. (assistant master, Royal Naval Engineering College, Devonport). Longmans, Green & Co. 7s. 6d. net.

A review must largely depend on the point of view from which the reviewer regards the work, and this is especially the case in this instance—namely, as to whether the work under review is to be regarded from an engineer's point of view, or from a purely scientific or physicist point of view. The work is evidently not intended for the ordinary engineering public, vital as the subject of thermodynamics is to engineering. The book bristles with differential and integral calculus from beginning to end, and it is evidently intended to meet the needs of the scientist, physicist, or advanced engineering student rather than the engineer in daily practice.

Dr. Max Planck is too well known to make it necessary to add that the present treatise is an admirable example of clearness and conciseness; the whole subject is treated in a masterly manner and from "a uniform point of view." His object being, as he states in the preface, to "present the entire field of thermodynamics from a uniform point of view . . . . it is rather as an introductory text-book on thermodynamics for students who have taken elementary courses in physics and chemistry and are familiar with the elements of the differential and integral calculus."

Dr. Planck selects to treat the subject by the more inductive method, which has proved the most fruitful, by keeping aloof from definite assumptions as to the mechanical theory of heat, and starting direct from a few general empirical facts, namely, the two fundamental principles of thermodynamics. This method, he holds, cannot be considered as final, but is that which corresponds best with the present state of things.

The total work covers some 260 pages, and the translator and publisher have wisely co-operated to keep the work clear and distinct and easy of reference.

Part I., composed of three chapters, deals with the fundamental facts and definitions underlying thermodynamics.

Part II. and Part III. are devoted respectively to the "First and Second Principles of Thermodynamics." These occupy six chapters, two of which are introductory, one to each part. The definition of "entropy" is dealt with in Chapter II. of Part III., and will be perused with interest by many after the discussion that has lately taken place on this subject.

Part IV. deals with "Applications to Special States of Equilibrium," and closes with a useful table of Dr. Planck's publications and papers on thermodynamics.

The work is a valuable contribution to the published literature on thermodynamics. The translator is to be congratulated upon bringing Dr. Planck's original German work within easy reach of the English scientist and student.

NEW PATENTS APPLIED FOR, 1903.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

22,497. "Improved electrical numerical switch." J. Makin. October 19th.

22,507. "Improvements in and relating to electrically-controlled hoists." J. A. Steven. October 19th.

22,532. "Improvements in and connected with electric arc lamps." J. O. Girdlestone and C. F. G. Thorkelin. October 19th. (Complete.)

22,572. "Improved method of and means for working electrical winding engines." Siemens Bros. & Co., Ltd. (Siemens & Halske Actien Gesellschaft, Germany.) October 19th. (Complete.)

22,573. "Improved safety fuse device for electrical installations." Siemens Bros. & Co., Ltd. (Siemens & Halske Actien Gesellschaft, Germany.) October 19th. (Complete.)

22,601. "Improvements in electrical switches for electric ignition as applied to internal combustion engines." F. H. Hall and C. Hall. October 20th.

22,606. "Improvements in apparatus for the generation of electricity primarily designed for the electric lighting of trains." T. W. S. Hutchins. October 20th.

22,634. "Improvements in or relating to terminals for stranded electrical and other wires." F. H. de Veulle. October 20th.

22,639. "Improvements in covers and frames for junction boxes, and the like." S. Robinson. October 20th. (Complete.)

22,643. "Improvements in brush-holders for dynamo-electric machines." M. E. Thompson. October 20th. (Complete.)

22,654. "An improved clip adapted to be used for suspending electric cables." T. H. Walker. October 20th.

22,664. "Contact apparatus for electric relay master clocks." O. Imray. (Siemens-Schuckertwerke G.m.b.H., Germany.) October 20th. (Complete.)

22,668. "Improvements in electrical insulators." J. E. Spagnoletti. October 20th.

22,673. "An improved current regulator for electric machines." A. R. Muller. October 20th. (Complete.)

22,674. "Improvements in and connected with telephone systems." P. Hardegen. October 20th. (Complete.)

22,680. "Improvements in and relating to coherers for wireless telegraphic systems." L. Dorman. October 20th. (Complete.)

22,696. "Electrical vibratory motor." C. S. Whitney. October 20th. (Complete.)

22,698. "Improvements in telephone transmitters." J. Prince. October 20th. (Complete.)

22,758. "An improved voltage-regulated electric lighting system for railway and other carriages." J. Dalziel. October 21st.

22,778. "Improvements in apparatus for commuting electric currents passing through combined arc and incandescent lamp circuits." C. Smart. October 21st.

22,785. "Improvement in storage battery plates." E. W. Smith. (Date applied for under Patents Act, 1901, September 10th, 1903, being date of application in United States.) October 21st. (Complete.)

22,800. "Improvements in and relating to electric belts for personal use." J. T. Pearson. October 22nd.

22,804. "Improvements in means for controlling electric circuits." H. Leitner and R. N. L. Lynton. October 22nd.

22,805. "Improvements in regulators for electric circuits." H. Leitner and R. N. L. Lynton. October 22nd.

22,820. "Improvements in electrical fuse-boxes or fittings." C. D. Burnet. October 22nd.

22,840. "Improvements in lampholders for electric lighting. A. M. Barnes. October 22nd.

22,858. "Improvements in or relating to electrically-synchronised clocks and the like." F. A. Chandler and B. Bonniksen. October 22nd.

22,904. "Improvements in controlling electric boosters." E. A. Carolan. (The General Electric Co., United States.) October 22nd.

22,905. "Improvements in electric rheostats." E. A. Carolan. (The General Electric Co., United States.) October 22nd.

22,906. "Improvements in machines for covering electric conductors or the like with insulating material." E. A. Carolan. (The General Electric Co., United States.) October 22nd.

22,907. "Improvements in and relating to controlling devices for electrically-propelled vehicles." E. A. Carolan. (The General Electric Co., United States.) October 22nd.

22,908. "Improvements in electric switches or circuit breakers." E. A. Carolan. (The General Electric Co., United States.) October 22nd.

22,909. "Improvements in dynamo-electric machines." E. A. Carolan. (The General Electric Co., United States.) October 22nd.

22,910. "Improvements in bearings for electric meters and other measuring instruments." E. A. Carolan. (The General Electric Co., United States.) October 22nd.

22,911. "Improvements in alternating current motors." E. A. Carolan. (The General Electric Co., United States.) October 22nd.

22,912. "Improvements in dynamo-electric machines." E. A. Carolan. (The General Electric Co., United States.) October 22nd.

22,913. "Improvements in alternating-current motors and methods of controlling the same." E. A. Carolan. (The General Electric Co., United States.) October 22nd.

22,955. "An electric wire terminal grip." W. H. Copus. October 23rd.

22,981. "Improvements in welding by electricity and apparatus therefor." J. Harmatta. October 23rd.

22,996. "Improvements in connection with incandescent electric lamp-holders with shade carriers." W. R. N. Gard. October 23rd.

23,021. "Improvements in electrical switches, cut-outs and the like." V. Hope. October 24th.

23,049. "Improvements in means for attaching wires to the terminals of sparking plugs and the like." E. W. Lewis. October 24th.

23,057. "Improvements in single-phase alternating current motors." B. G. Lamme. (Date applied for under Patents Act, 1901, October 31st, 1902, being date of application in United States.) October 24th. (Complete.)

23,086. "Improvements in or relating to the regulation of dynamo-electric generators." M. H. Kilgour. October 24th.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1903.

8,778. "Improvements in electrically-propelled road vehicles." L. Kriéger and La Compagnie Parisienne des Voitures Electriques (procédés Kriéger). (Date applied for under Patents Act, 1901, September 22nd, being date of application in France.) Dated April 17th.

8,900. "Improvements in apparatus for the production of galvanic deposits." E. Müller. Dated April 20th.

8,964. "Improvements in electric batteries." S. Yai. Dated April 21st.

9,015. "Improvements in electrical generators for producing alternating currents of low frequency." Siemens Bros. & Co. (Siemens & Halske Aktien-Gesellschaft, Germany.) Dated April 21st.

9,029. "Improved means of suspending electric incandescent lamps." M. H. Gallsworthy and The London Electrical Fittings Co., Ltd. Dated April 21st.

9,115. "Improvements in trolleys for electric railway cars on the overhead system." W. A. Daggett. (Date applied for under Patents Act, 1901, April 22nd, 1902, being date of application in U.S.A.) Dated April 22nd.

9,126. "Improvements in measuring electrical energy." W. E. Evans. (Allgemeine Elektricitats Gesellschaft, Germany.) Dated April 22nd.

9,149. "Improvements in or relating to pull down or safety apparatus for the trolley poles of electric cars." H. Birkbeck. (The Electric and Steam Railway Supply Co., U.S.A.) Dated April 22nd.

9,206. "Improvements in method of and apparatus for transforming electrical energy." P. C. Hewitt. (Date applied for under Patents Act, 1901, April 25th, 1902, being date of application in the United States.) Dated April 23rd.

9,353. "Improvements in and connected with shade-holders for electric lamps." G. Birch. Dated April 25th.

9,372. "Improvements in insulators applicable to overhead tramway wires." J. A. Penny. Dated April 25th.

10,100. "An improved automatic heat-operated electric circuit closer." T. Barnett and J. Darge. Dated May 4th.

10,194. "Improvements in electric furnaces." J. M. Carrere. Dated May 5th.

10,298. "Improvements in secondary or storage batteries." H. H. Lake. (R. Darling and L. Chronik, U.S.A.) Dated May 6th.

10,703. "Improvements in primary and secondary electric cells." G. Harrison. (M. Buffa, Germany.) Dated May 11th.

11,193. "Improvements in or relating to radiators for wireless telegraphy." A. Biondel. Dated May 16th.

11,426. "Improvements in vibrators for sound telegraph apparatus." A. A. Lind. Dated May 19th.

11,591. "Improvements in signalling systems for electric railways." G. Gibbs. (Date applied for under Patents Act, 1901, May 22nd, 1902, being date of application in the United States.) Dated May 21st.

11,634. "Improvements in or relating to conductors and collectors for electric traction." A. Megroz. Dated May 21st.

11,698. "Improvements in self-regulating systems for electric light and power." S. E. Page. (A. S. Adler, U.S.A.) Dated May 22nd.

11,751. "Improvements in regulating apparatus for electrical circuits." E. F Moy and P. H. Bastie. Dated May 23rd.

11,826. "Improvements in and relating to electric driving mechanism for centrifugal machines." W. E. Evans. (Allgemeine Electricitäts Gesellschaft, Germany.) Dated May 23rd.

12,093. "Improvements relating to electric traction systems." H. H. Lake. (L. T. Gibbs, U.S.A.) Dated May 27th.

12,119. "A method of receiving electrical vibrations with the use of electrolytic cells." W. E. Evans. (Allgemeine Elecktricitats Gesellschaft, Germany.) Dated May 27th.

12,203. "Improvements in electric burglar alarms." B. F. Schubert. Dated May 28th.

12,982. "Improvements in or relating to conduits, conductors and contact devices, or collectors for electric railway and tramway systems." A. Kuchinka. Dated June 9th.

12,968. "Improved and portable electric lamp." P. Schwenke. Dated June 9th.

13,176. "Improvements in electric railway and tramway vehicles." G. Gibbs and H. Pearson. (Date applied for under Patents Act, 1901, October 2nd, 1902, being date of application in the United States.) Dated June 12th.

13,281. "Improved device to be used in connection with telephone receivers." J. Capell. Dated June 13th.

13,805. "Improvements in the brush boxes of dynamos and motors." W. H. Allen, Son & Co., Ltd., and C. C. Hawkins. Dated June 18th.

14,021. "Improvements in galvanic batteries." P. Brandt. Dated June 23rd.

10,429. "An improvement in apparatus for measuring electrical resistance." A. G. Bloxam. (A. Schoeller, Germany.) Dated May 7th.

10,518. "Improvements in and relating to cut-outs or circuit breakers for overhead electric wires." J. S. Withers. (J. Massier, France.) Dated May 8th.

10,519. "Improvements in and relating to cut-outs or circuit breakers for overhead electric wires." J. S. Withers. (J. Massier, France.) Dated May 8th.

10,546. "Improvements in contact boxes for surface contact electric railway systems." W. M. Brown and Earl Porter Wetmore. Dated May 8th.

12,458. "Electrical rail bonds." W. H. Wherry. Dated June 2nd.

12,461. "Couplings for electrical conductors." W. H. Wherry. Dated June 2nd.

12,563. "Improvements in coin actuated electrical apparatus." J. Rose and Rose, Coop & Rissone, Ltd. Dated June 3rd.

12,629. "Improvements relating to electric alarms." C. E. Grouselle and V. E. Manouvrier. (Date applied for under Patents Act, 1901, March 5th, 1903, being date of application in France.) Dated June 4th.

14,176. "Improvements in electric heaters or rheostats." F. C. Newell. (Date applied for under Patents Acts, 1901, June 27th, 1902, being date of application in the United States.) Dated June 25th.

14,904. "Improvements in or relating to telephone systems with central battery." G. B. T. Piltz. Dated June 25th.

14,568. "Improvements in and relating to electro-magnets." D. L. Lindquist. Dated June 30th